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HOMO SAPIENS—WHENCE AND WHITHER[1]

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INTRODUCTION

THE male human creature in our society is supposed to have "come of age" when he has completed his twenty-first year. An alleged scientist ought to have attained his majority when he has passed the twenty-first anniversary of his professional career. Unfortunately he may remain forever a minor, even if he has reached the "age of discretion." Nevertheless, I propose to survey the increments to our knowledge of that animal, man, during the past score and odd of years, whether my utterances be the brash pipings of the callow juvenile, the resounding platitudes of waisty middle age or the reminiscent quaverings of senility. In any event, I firmly absolve myself from responsibility for the anthropological accretions of which I here take note, since any pebble which I in passing may casually have dropped upon the rock pile, has simply disappeared in the chinks between the ponderous contributions of my more substantial colleagues. In short, like the famous young man on the hearse, I have just come for the ride.

[1] The thirteenth annual Sigma Xi lecture, given at a joint session of the American Association for the Advancement of Science and the Society of Sigma Xi, Pittsburgh, Pa., December 28, 1934.

NEW VIEWS OF PREHUMAN PROBLEMS

One may well begin with some new angles from which recent observers have viewed prehuman problems. These are zoological angles rather than mathematical angles. Nevertheless, some of them are acute and others are obtuse. The first problem which may be viewed thus askance is that of the origin of the primates. (I refer to the zoological order rather than to the ecclesiastical order.) The research of the last two decades has aroused suspicion that the primates

had an origin which was at once lowly and lofty—lowly because they appeared to have sprung from primitive and timorous insectivores, lofty because these insectivores in some previous incarnation had been chased up a tree. There they remained, supposedly, cutting down their litters and their claws, sacrificing philoprogenitiveness for security, and efficiency in scratching for facility in gripping with opposable thumbs and great toes. In the fullness of time and species gestation, some ambiguous and generalized insectivore was suspected to have given birth to a primate. And believe it or not, this adventure in obstetrics was accomplished by an animal whose static collateral descendant is called a tree shrew (a designation which seems to have been a sort of *ex post facto* prophecy of the articulate gift of that ultimate primate, woman).

However, this simple view has been challenged by the recent ruminations of comparative anatomists. Thus W. E. Le Gros Clark has lately reached the conclusion that the tree shrews must be recognized not as progenitors of the primates, but rather as early secessionists from a primitive primate stock which had already spawned proto-lemuroids.[2] Thereby a mother is degraded to a niece. Some of you may have swallowed our alleged affinity with the anthropoid apes without even a gulp, may have choked down our putative relationship to the regrettably obscene monkey, but may have gagged over the glassy-eyed, frozen-faced lemur, which suggests the product of some unhallowed alliance between a degenerate fox and a libertine marmoset. For these, if such there be, I have a word of cheer. Le Gros Clark and other meticulous primatologists have summarily banished from the assemblage of our ancestors the lemur, the loris and all their ilk. This means that it is no longer "legitimate" to speak of a "lemuroid" phase in the evolutionary history of the Anthropoidea, which include monkeys, apes and man. You may well inquire whose tree it is upon which our simian forbears have perched. The answer is "Tarsius spectrum." Who then is this Tarsius who comes knocking for admission to the genealogical order of Daughters of the Human Evolution? The contemporary animal is the size of a small rat, with a furry body terminated by a long tail bare in the middle and hairy at both ends. It has monstrous eyes, seemingly directed forward, very large ears and a pinched and retracted snout. Its ankle bones are enormously elongated (whence the name Tarsius). It hops on its hind legs like a miniature kangaroo. The five digits of its hands and feet are provided with sucker disks; the thumb and the great toe are opposable to the other digits; the second and third toes are clawed. Tarsius is arboreal and nocturnal; it produces one young at a birth and feeds itself with its hands. This otherwise somewhat eccentric animal, found to-day only in the Indo-Malayan Archipelago, has become the storm center of a zoological controversy. It displays a certain number of features suggestive of a real affinity with the higher primates—among them the absence of a moist muzzle, the conformation of the external genitalia, the form of the incisor and premolar teeth, the type of the placenta, the tubular shape of the auditory meatus, *et cetera*. In some other features it is related to the lemurs or merely "apes the apes."[3] Particularly because Tarsius sits erect, feeds itself with its hands, has a short snout, frontally directed eyes and a brain in some respects well-developed, ingenious anatomists have made it the hero of a sort of scientific Just So story of primate evolution. Thus hopping and squatting on the hind limbs encourages an upright body poise and "emancipates" the fore limbs. These pentadactyle extremities, clawless and with opposable thumbs, may now be used for all the varieties of mischief which Satan has for idle hands to do. They can investigate the animal's whole corporeal entity and adjacent objects of the external world. They can be used to lift things toward the eyes for visual examination, toward the nose for olfaction and toward the mouth for tasting, chewing and swallowing. In short, these emancipated hands become not only mere conveyors of nourishment, but instruments of research and investigation and the potential creators of tools and all the appurtenances of material culture. However, the mere prehensile function of the hands is of small import in comparison with the secondary effects of this new usage upon other organs. The exploratory digits relieve the snout of its tactile function; the feeding fingers absolve the jaws from grazing duties; the protrusive muzzle recedes, and the laterally directed eyes (apparently in a strabismic effort to ascertain the fate of the vanishing snout) swivel round to the front so that the fields of vision converge. The animal can now look down its nose to examine with stereoscopic clarity and depth the object presented by its prehensile hands. The recession of the overbalancing jaws gives poise to the head and facilitates rotary movements, so that parts of the body previously invisible are presented to the sight, as well as being accessible for palpation. Sound waves are now caught by turning the head instead of cocking the ears; the latter curl up. As the jaws shrink, the temporal muscles relax their constricting grip upon the skull vault, and reluctantly retreat down the parietals. This of course gives the brain its chance. But the modest yet ambitious neopallium has other incentives for expansion. The investigative

[2] W. E. Le Gros Clark, "Early Forerunners of Man," p. 250, London, 1934.

[3] Le Gros Clark, *op. cit.*, p. 265.

digits seek and acquire in the brain cortex not only motor representation but also adjacent areas of pictured movements; now the animal can not only see what it is doing but can also recall to the mind's eye past actions and can even build castles in the air. Naturally association areas then spread like a rash; the neopallium becomes furrowed with thought; the brow bulges with cerebration. All this we owe to Tarsius—a humble primate Prometheus. If you are a functionalist, you may thumb your nose at the specter of Weismann, and accept as your ancestor this spectral tarsier thumbing its way along the ascending road of evolution—hopping toward humanity. A slight difficulty may indeed obtrude itself when one considers certain specializations of this, our ratlike ancestrix. We ought with such a pedigree to have the gait and pedal extremities of a kangaroo, and eyes like teacups, millstones or towers—such as those possessed by the three marvelous dogs in Hans Andersen's story, "The Tinderbox." For it appears that even the earliest fossil tarsioids exhibit evidence of enlarged orbits and elongated ankles. Here, forsooth, we find ourselves impaled upon the horns of a dilemma: either we are descended from a tarsioid which had not yet become specialized for hopping and had refrained from orbital exaggeration, or else our tarsioid or subsequent ancestors have violated the law of the irreversibility of evolution. In the former case we are indeed lost, because if there was no hopping there could have been no handling, no hand feeding, no cortical representation, no Anthropoidea, no *Homo sapiens*. In the latter case we dare not face the paleontologists.

As a matter of fact, it is comparatively simple to evade both of these difficulties. In the first place we need not accept literally the Lamarckian lucubrations of Professors Elliot Smith and Wood Jones, whereby Tarsius in merely sitting up initiates a perpetual motion of motor cause and cortical effect which inevitably leads onward to humanity. The only existing primate of certain tarsioid ancestry is the diminutive goggle-eyed beast of Borneo, which is apparently no farther away from man than the most of the twenty fossil species of Eocene tarsioids. The dog-faced baboon is not only an inveterate hand-feeder but also a confirmed quadruped, which has either redeveloped a prodigious snout in utter defiance of the law of irreversibility or, having preserved and enlarged a primitive primate snout, has nevertheless managed to rotate his eyes around to a frontal plane and to achieve stereoscopic vision, with a complete disregard of the views of Professor Frederic Wood Jones.

The so-called law of the irreversibility of evolution is easy to circumvent by a sophistry which enables the paleontologist or zoologist to include in man's ancestral line the fossil precursors of almost any primate, however specialized its modern descendants. Thus in the case of tarsioids it is merely necessary to state that man's ancestors have sprung from a generalized proto-tarsioid stock which had not yet developed the evolutionary specializations, which would rule the modern tarsier and most fossil tarsioids out of the human line of descent. In this way the zoological genealogist manages both to eat his cake and to have it.

Another convenient device much used in evolutionary dialectics is known as the "law of convergent or parallel evolution." This law affirms that similar or identical variations may be developed independently in unrelated forms "which happen to be subjected to similar environmental forces."[4] Citation of this law enables the fabricator of family trees to dismiss as irrelevant and illusory all morphological similarities in those animals which he wishes to exclude from close relationship to man. Wielding the law of irreversibility of evolution in one hand, and that of convergent evolution in the other, the brain trusters of the zoological New Deal can excommunicate from the assemblage of man's ancestors any unfortunate stock of which the contemporary representatives seem undesirable poor relations. Conversely, by a skilful blending of motifs upon the same two instruments, the pied pipers of primatology lead off ratlike tarsiers and godlike men in one genealogical rout. Actually these alleged evolutionary laws are more honored in the breach than in the observance, even by those who most loudly invoke them. Hence the mere anthropologist remains unimpressed when Professor Wood Jones in a single burst of zoological rhetoric reads out of man's party the tree shrews, the lemurs, all the monkeys and even the anthropoid apes. However, even the ardent advocates of parallelism and irreversibility are ill content to leave man out on the end of a limb with no company in his family tree except that of a nebulous, nocturnal tarsier.

Yet, apart from the heresy of Wood Jones, who has seceded in a body from orthodox opinion as to man's descent, other minor dissensions have arisen in the ranks—voiced at times by major dissentients. Thus we have to deal with the growing heresy which maintains that man is not descended from a giant brachiating ape, but from some small ground-walking anthropoid which had abandoned tree life and cut himself off from relationship with the arboreal ancestors of the great apes as far back as the Oligocene period. This infant Ishmael seems to owe his existence principally to an unhappy afterthought of Professor Dudley J. Morton, added to his otherwise

[4] Le Gros Clark, *op. cit.*, p. 5.

admirable memoir upon the evolution of the human foot.[5] Morton observed that the mid-tarsal pattern of the gibbon resembles that of the monkeys, whereas in the great apes this region of the foot is decidedly shortened. Man appears with the more primitive pattern of a long mid-tarsal region. Morton therefore infers that man could have avoided the mid-tarsal shortening only by separating from the great ape stock before it occurred. He suggests that the shortening of the mid-tarsal region in the great apes has been the effect of the attainment of a great body bulk, the weight of which has crushed the mid-tarsal bones, and that man gained this great increase in size after he had adapted the use of his foot so that the crushing effect of body-weight would not be exerted upon the mid-tarsal area. Dr. Morton further concludes that "the retention of the more primitive mid-tarsal pattern supplies evidence of three phases in man's history; the early attainment of the erect posture, separation from the great ape stock before it had attained its modern large size and early adoption of terrestrial habits." This sweeping conclusion has been greeted with acclaim by the protagonists of the Homunculus theory, *i.e.*, the diminutive dawn man. For my part, I see no reason why "Wolff's law" of atrophy and hypertrophy, which Dr. Morton frequently invokes, should turn a somersault by "crushing" the mid-tarsal region when the bodily weight is transmitted to it, although enlarging the heel-bone when the bodily weight rests upon the latter. If one insists upon crying "Wolf! Wolf!" when there probably is none, one may as easily ascribe the supposed shortening of great apes' mid-tarsal region to adaptation for greater mobility in grasping; or to atrophy as a result of these animals' brachiating habits, whereby they suspend the weight from the hands rather than rest it upon the feet.

On the whole it seems to me that it is most unsafe to attempt to determine degrees of phylogenetic relationship solely by the examination of resemblances and differences in such a highly adapted organ as the foot. The only safe bases for reckoning affinity are hereditary, non-adaptive variations of organs in which form is not closely dependent upon function. The foot and the pelvis in man are perhaps of all skeletal parts the most rigorously adapted to human bodily habits and to functional needs. By virtue of such stringent adaptation they are the least suitable structures from which to deduce phylogenetic conclusions. Zoological classification should never rest upon the evidence of any single anatomical character, however important, but always upon the cumulative testimony of as many non-adaptive hereditary features as can be marshalled for examination. Beware of special pleaders who would chart the course of primate evolution by the use of a compass whose needle points always to the same magnetic pole—whether it be the tarsus, the tympanic ring, the frontal sinus, the placenta or the pattern of molar teeth! Gifted persons may conjure rabbits out of silk hats or *Homo sapiens* from a hopping tarsier, but though the hand may be quicker than the eye, no one need believe that the topper has conceived a bunny.

It is with relief that one turns from the school of prestidigitative or saltatory evolutionists to the tortoisian plodders who escort our postulated progressive primate to the goal of humanity by a slower and less spectacular, but surer route. As the heavyweight champion of the great ape theory of human descent, we may acclaim Dr. William King Gregory, who has suffered the bludgeonings of Wood Jones and the pro-tarsioids and has emerged with head not only unbowed, but not even perceptibly bloody. Dr. Gregory neglects no biological system which may furnish evidence apposite to the solution of the problem. He makes a clean sweep through the whole range of vertebrate evolution. Although he displays an astounding familiarity with all the minutiae of vertebrate anatomy, Professor Gregory is perhaps most intimate with the development of the skull and the teeth. He is indeed such a consummate master of odontology that, were we to start anew with a planned, controlled and supervised organic evolution, we should without doubt entrust to him the destiny of dentition, merely stipulating that he devise this time a less cumbersome and misleading terminology. In his most recent monograph entitled "A Half Century of Tritubercuły" (which is not to be mistaken for the autobiography of a trebly afflicted unfortunate), Dr. Gregory convincingly describes eleven stages of molar tooth development leading from primitive fish to modern man, the ninth or anthropoid ape stage giving rise to a five-cusped lower molar with a so-called Dryopithecus pattern of cusps and grooves, which is preserved in the first molars of the most primitive and many modern men. Gregory considers the evolution of the locomotor skeleton, the jaws and teeth, the face and the brain-case, carrying the story of each from the early vertebrate forms up to the human culmination, all themes of the various narratives leading to the conclusion that man developed in late Tertiary times from a giant, brachiating, arboreal ape of a generalized Dryopithecus type. Dryopithecus is the name of a family of anthropoid apes represented by numerous fossil jaws and teeth from the Miocene and Pliocene deposits in Europe, Africa and Asia. Unfortunately the remains are

[5] Dudley J. Morton, *Am. Jour. Phys. Anthrop.*, V: 4, 305–336, 1922; VII: 1, 1–52, 1924. *Cf.* especially p. 36.

usually restricted to jaws and teeth, because these are the most durable parts of the skeleton, being also especially tough and indigestible morsels. But a femur from the Lower Pliocene in Germany, referred to Dryopithecus, apparently represents the anthropoid thigh bone before it was affected by giantism, and is long and slender like that of a gibbon. Schlosser could discover in it nothing that would forbid its giving rise to the more specialized and shortened femora of the great apes or to the hypertrophied thigh-bone of an upright bipedal man. Moreover, the humerus supposed to belong to this same early anthropoid ape is shorter than the femur, contrary to the condition in the modern specialized great apes.

An important discovery of the past decade is that of the skull of a juvenile anthropoid ape at Taungs, Bechuanaland, South Africa. This specimen consists of most of the face and forehead and a cast of a portion of the brain. Professor Raymond Dart, the describer, gave it a place between the highest anthropoid apes and the lowest grades of humanity. Sir Arthur Keith has concluded that this fossil, Australopithecus, was an ape with a closer resemblance to the chimpanzee than to the gorilla, but a cousin form to both.[6] Nevertheless, in the volume of the brain, in the reduced size of the milk canine and in the persistence of certain infantile traits, Keith thinks that this ape approaches nearer to the human prototype than any form heretofore discovered.

More recent still is the preliminary notice of new anthropoid apes from India by the Yale North India Expedition.[7] These finds include several new genera and species which, in the shape of the dental arch, the reduction of the canines, the absence of diastemata, or gaps, are said to approach so closely to the human type that they may well be near the stem which led to the Hominidae proper. Such finds raise high hopes that we may yet discover the remains of that miraculous evolutionary deviant among the apes, which eventually foisted upon the faunal world Huxley's erect and featherless biped.

Within the past year Dr. S. Zuckerman has published a fascinating work on the functional affinities of man and the other primates.[8] He has assembled the evidence relating to differentiation of the mechanism of reproduction, blood reactions, visual and olfactory processes, behavior patterns, diseases and parasites, affinity and divergence, as shown by hybridization, psychological measures of intelligence, implications of cortical physiology. Zuckerman concludes:

> Man's immediate phyletic relationship to the ancestors of the anthropoid group of Primates cannot be doubted, unless it be argued that he developed the same blood groups, the same serum proteins, and the same peculiarities in purine metabolism independently of the anthropoids.[9]

Nevertheless, after an impartial review of the physiological evidence, he feels that it is impossible, in our present state of knowledge, to determine whether man's divergence from the common anthropoid-humanoid stock took place in the Oligocene before the present great apes had differentiated or at some subsequent period. For he points out that such physiological peculiarities as the blood groups, which man shares with the anthropoids, seem most probably to have developed independently in the different stocks, and are therefore due to convergent or parallel evolution and orthogenetic evolution within the confines of a natural subgroup.

In the past two decades experimental psychologists have become ape-conscious, and one of our great universities has been a pioneer in the recognition of the academic status of the chimpanzee. There has been accumulated a mass of experimental data tending to show that monkeys and apes differ from other mammals in that the former manifest a characteristic called "insight," which implies a complete solution of an experimental problem as a result of a general survey of the entire layout. This behavior with "insight" is contrasted with the "trial and error" method generally believed to be characteristic of lower animals. Gradually an edifice has been built up which seems to start with the inferior intelligence of rats in the basement and to progress upward story by story until it reaches the almost human faculties of the anthropoids on the roof, man with his supreme endowment hovering over all. Thus Yerkes and Yerkes in 1929 were able to conclude their colossal work upon the great apes with a formidable list of psychological contrasts between primate types:

> phylogenetic differences in behavioral expressions of curiosity, interest, attention, emotion, mood, sentiment; confidence in man and intelligent cooperation with him, rapidity and extent of adaptation to captivity; diversity and complexity of receptivity, sensibility, and perception, functional importance of contact senses, degree of value and dominance of hearing and vision; analysis and synthesis of mental objects; vocalization, approach to speech, intercommunication by visual and auditory signs and symbols; diversity of actions in problematic situations; frequency and importance of accidental (trial and error)

[6] Sir Arthur Keith, "New Discoveries Relating to the Antiquity of Man," pp. 37–116, New York, 1932.

[7] G. Edward Lewis, *Am. Jour. Sci.*, XXVII: 161–179, March, 1934.

[8] S. Zuckerman, "Functional Affinities of Man, Monkeys and Apes," New York, 1933.

[9] S. Zuckerman, *op. cit.*, p. 169.

adaptations; ability to perceive and react adaptively to relations (structure-function) *versus* familiar objects; insight, understanding, anticipation, expectation, disappointment, foresight; preadaptation; temporal span and complexity of memory; creative imagination, versatility, ingenuity, inventiveness, constructivity; adaptive modification of environment, modification of other organs by tuition or instruction, use of objects as instruments, construction or fashioning of implements.

Some of these phenomena are observable in all primates, some in all except the Prosimiae, others only in ape and man, and a few in man alone. Usually vast gulfs separate the types, and with a few exceptions the indicated or definitely demonstrated trend of development and serviceability is from lemur to man.[10,11]

Unfortunately, even this grand and towering structure has been scarred recently by bullets of revolutionary and communistic snipers who will have none of this primate hierarchy. Thus Zuckerman points out that the term insight is no explanation of behavior, but simply an aid to description which leads nowhere if too much reliance is placed upon it.[12] It is rather disconcerting to discover that behavior with insight, so far from being an exclusive prerogative of higher primates, is also characteristic of cats, dogs and even of rats. It is even more discouraging to learn that an ordinary American monkey tested by Dr. Haan seemed to be no less intelligent than the chimpanzee and much more so than the gorilla, orang, and gibbon. Various other investigators, whose work is summarized by Zuckerman, have apparently found that there is no exact positive correlation between zoological status within the primates and so-called measures of "intelligence."

On the whole, then, it would appear that the labors of paleontologists, comparative anatomists and psychologists have not yet led to any precise determination of man's relationship to individual genera and species of the primate order. No primate with a properly developed instinct of self-preservation would be willing to entrust his weight to any of their zoological family trees.

For myself, a naive physical anthropologist, the way still seems comparatively straight and plain. I adhere to the old-fashioned belief that the more numerous and detailed the resemblances between two animals the closer the relationship between them. Effects of similarity or difference of habitus can not obscure man's fundamental likeness to the great anthropoid apes, and especially to the gorilla and the chimpanzee. I therefore persist in the opinion that these two apes are our nearest collateral relatives, and as yet am aware of no convincing evidence which conflicts with the theory that the gibbon was an early deviant from a small and primitive generalized anthropoid ape stock; that the main line of anthropoid-humanoid development continued at least into the Miocene period, when giantism began to affect simultaneously the diversifying strains of these arboreal apes. Then it would appear that the ancestors of the orang-utan first began their course of evolutionary divergence, leading ultimately to a rigid specialization for slow brachiating. For some time thereafter it seems probable that the ancestors of man and the African apes pursued similar evolutionary courses, until accident or initiative (and I favor the latter explanation) led the protohuman stock to take its chance on the ground. This radical change of habitus must have taken place before our ancestors had undergone any of the excessive specializations consequent upon brachiation, which have involved the hypertrophy of the upper limbs and comparative atrophy of the lower limbs in contemporaneous great apes. But I see no reason for supposing that the descent to the ground occurred before the latter part of the Miocene period, when man had already stamped upon his molar crowns the indelible sign of his Dryopithecus heritage.

[10] R. M. Yerkes and A. L. Yerkes, "The Great Apes," p. 578, New Haven, 1929.

[11] This quotation recalls Huckleberry Finn's comment upon Bunyan's "Pilgrim's Progress": "The statements was interesting, but tough."

[12] S. Zuckerman, *op. cit.*

The Enigma of Fossil Man

In the past two decades the specialists who deal with fossil man have been confronted with an ever-increasing number of geologically ancient skeletal remains, each succeeding one apparently adding to an existing confusion. At the beginning of the century the tale of fossil man was brief and apparently fairly intelligible. A series of finds in Western Europe had revealed the bony remains and the stone implements of a race of men who inhabited caves during the last glacial advance. These Neanderthaloids were short, bull-necked, barrel-chested individuals, with many features of the bones of the trunk and of the extremities suggesting an affinity with the great apes less remote than that of modern man. The most striking features were, however, those of the skull. The long and narrow brain-cases were of moderate size or even large, but flattened down and low; their orbits were surmounted with huge bony browridges, behind which the forehead retreated in an ignominious fashion. The jaws were protrusive to the verge of snoutiness; the chin receded practically to a vanishing point; the teeth were massive but without canine projection; the pulp cavities of the molars were enlarged, as in animals which chew the cud. These apish men seemed to fulfil the requirements of an early ancestral human

type which had not yet sloughed off many of its anthropoid attributes. They were succeeded in the upper strata of the European caves, representing the last glacial retreat, by several morphologically modern types of man. In 1907 a sand pit near the university town of Heidelberg yielded a massive human jaw which looked like a plausible progenitor of the Neanderthaloid race. This mandible was referred to the first or second interglacial period, many scores of thousands of years before the flourishing of the Neanderthalers. Also in 1892 a Dutch scientist had unearthed a most extraordinary humanoid fossil in the island of Java, apparently dating from the beginning of the Pleistocene period or the end of the Pliocene. This specimen consisted of a very apish skull-cap, too large for any existing anthropoid ape and too small for any man except an idiot, a few ambiguous teeth and a thigh-bone which certainly belonged to an erect biped. This thing was christened *Pithecanthropus erectus*, "the erect ape-man," and was generally conceded to be nature's finest effort in production of a "missing link." Without unduly stretching phylogenetic possibilities, one might conceive of Pithecanthropus as a late survivor of a stock which had already crossed the threshold of humanity, having achieved erect posture and biped gait, without as yet having attained a full quota of brain. It was further possible to suppose that some Pithecanthropidae with superior genes had produced the higher Heidelberg type, which again, stimulated by the Kultur of the Pleistocene, ultimately evolved the Neanderthalers. These last, in the throes of species parturition, were held by some to have given birth to modern man, apparently themselves expiring with the effort. These were the short and simple annals of the poor Hominidae. It is true that certain recalcitrant Thomases had interposed doubts, calling attention to various skeletal finds which suggest that morphologically modern man existed in Europe even before the advent of the Neanderthalers, and asserting that Pithecanthropus was a paleontological monster fortuitously assembled from spare parts of men, apes and microcephalic idiots.

However, about the time that the politicians were stirring up a world war, an inquisitive amateur geologist trespassed upon a small gravel pit in a Sussex lane near Piltdown Common and disinterred some skull fragments which were subsequently named Eoanthropus Dawsoni, but might better have been called Pandora. The brain-case of this early English female, although of extraordinary thickness, was of essentially modern configuration and of capacious size, lacking low forehead and great brow-ridges, whereas the half of the mandible discovered was chinless and almost indistinguishable from that of a chimpanzee. There was also included in the Piltdown remains a tusk-like projecting canine tooth. Hence, if the associated remains were assigned to one individual, it was necessary to suppose that at the beginning of the Pleistocene period there existed a type of man with a modern brain-case and a projecting, chinless, apelike jaw. Such a being could not be fitted into the line of descent which includes Pithecanthropus, Heidelberg man, and the Neanderthal race, since all these fossils were probably provided with large brow-ridges and receding foreheads. Some authorities attempted to solve the problem by supposing that the brain-case and the mandible belonged to two different individuals—one a man and the other a chimpanzee. But this supposition involved an incredible stretching of the long arm of coincidence. Although it was rejected by the majority, few seemed to possess the imagination to grasp the implications of this radically disharmonic type of fossil man, and to deduce from it the logical conclusions as to human descent. Almost alone, Sir Arthur Keith committed himself unhesitatingly and definitely to the theory that human evolution has been a multiple and asymmetrical process, involving the differentiation of a number of distinct genera and species of man, of which Pithecanthropus, Heidelberg and the Neanderthaloid group represent lines which are not directly ancestral to *Homo sapiens*. According to this view, Piltdown man (Eoanthropus Dawsoni) represents a survival into the Early Pleistocene of a Pliocene form which had already developed modern brain size, but had not as yet undergone the reduction of the jaws and the refinement of the dentition characteristic of morphologically modern man.

One of the cardinal tenets of Sir Arthur Keith's position was his defense of the Early Pleistocene dating claimed for the Galley Hill man, a skeleton discovered in the 100-foot gravels of the Thames Valley as early as 1888. The bones were those of a short-statured adult male with no especially apelike features. The skull is very long and narrow, without excessive development of brow-ridges or of frontal slope; the jaw has a well-developed chin and the teeth are not extraordinary. This find is merely the most famous of a fair number of morphologically modern human bones for which Middle Pleistocene or earlier age has been claimed. All these finds had been rejected by the majority of anthropologists on the explicit ground that their geological provenience was questionable, but implicitly because of the belief that the occupation of Europe at the end of the glacial epoch by apelike Neanderthalers delimited the extent of human evolution at that period. It was then in-

conceivable that an anatomically modern type should have ranged Europe one or two glacial cycles previously.

In the meantime fresh discoveries seemed to substantiate the opinion that modern man must have evolved through a generalized Neanderthaloid stage. In 1921 the Rhodesian man was exhumed in South Africa—a specimen which in size of face and upper jaw exceeded any human type previously known, and which, in the hugeness of its brow-ridges, virtually out-gorillaed the gorilla. Yet this skull displayed also a mixture of anthropoidal and modern human features, and the limb bones uncertainly associated with it were those of a recent type of man. Nevertheless, most authorities elected to classify Rhodesian man as a variant of the Neanderthal type.

Then came the series of discoveries in Peking, China, beginning in 1927 and closely associated with the industry and scientific acumen of the late Professor Davidson Black. The Sinanthropus crania, of Lower Pleistocene date, are of an evolutionary status intermediate between that of *Pithecanthropus erectus* and the well-known Neanderthal race, although possibly neither the descendants of the one nor the progenitors of the other.

Certain other new discoveries might be interpreted as consistent with the hypothesis that *Homo sapiens* has evolved through a Neanderthaloid stage. These include the Galilee and Steinheim crania, the skeletons from the Wady-al-Mughara in Palestine, and the so-called *Homo Soloensis*—the latter including several Late Pleistocene crania recovered near the same site which yielded *Pithecanthropus erectus*. Most of the finds just enumerated have not yet been described adequately. Incomplete information indicates that several of them show a mixture of Neanderthaloid characters with those usually found in *Homo sapiens*. For example, the series of nine Palestinian skeletons, at present not yet disengaged from their stony matrices, are said to combine truly Neanderthaloid frontal tori with high skull vaults, low attachments of the nuchal musculature, well-developed chin eminences, and limb bones of modern conformation. If these preliminary indications are substantiated it is evident that at least three possibilities must be considered: (1) that these skeletons represent Neanderthal man evolving into *Homo sapiens*; (2) that they are hybrids between Neanderthal and some form of *Homo sapiens;* (3) that certain skeletal characteristics, usually regarded as peculiarly Neanderthaloid features, were sporadically distributed through a number of separately evolving human stocks.

Most recently, however, there has been announced a portentous discovery, which, if completely validated, should once and for all relegate such forms as Sinanthropus, Heidelberg and all the Neanderthaloids to the blind alleys branching off from the main highway of human evolution. These new remains were recovered from a site on the south side of the Kavirondo Gulf of Victoria Nyanza, British Africa, by the English archeologist, L. S. B. Leakey. At Kanjera were found fragments of three skulls, in a stratum which yielded implements of the Chellean type of industry, and fossil bones which seem to date the deposit from the Middle or Early Pleistocene. While complete reports are not yet available, it is stated that all these fragments belong to a type of man devoid of a supraorbital torus and in no wise distinguishable from *Homo sapiens,* except in the retention of certain infantile and primitive characters. At another and older site, Kanam, a fragmentary human mandible was found *in situ* in a stratum characterized by fauna which must be at least Lower Pleistocene if not earlier in date, together with stone tools of a pre-Chellean type. This mandible is pronounced by the finder to be very similar to that of *Homo sapiens,* and quite possibly an ancestral form. Thus it is wholly probable that here at last we have the complete vindication of Sir Arthur Keith's opinion of the high antiquity of *Homo sapiens.** We may then have to rescue from the Potter's Field of human paleontology Galley Hill, Olmo, Castendolo, and I know not what other dusty and neglected bones, and accord them their rightful place in the gallery of our early ancestors.

While the scientists have been steadily adding to the number of accredited remains of fossil man in the Old World, during the past quarter of a century that formidable and indomitable veteran, Dr. Aleš Hrdlička, has stood like Horatius at the land bridge between Asia and North America, mowing down with deadly precision all would-be geologically ancient invaders of the New World. In fact, the story of alleged fossil man in America is virtually the tale of how well Hrdlička kept the bridge. With penetrating analysis and devastating criticism he has annihilated *seriatim* the claims of each successive fossil pretender. Undoubtedly he has preserved science from a credulous acceptance of many spurious Pleistocene Americans. It is indeed passing strange that, if man really inhabited the New World during the Pleistocene epoch, we have not found his implements and his bones *in situ* in indubitably Pleistocene deposits, and associated with extinct animals which do not incur the suspicion of having survived into recent times.

A reliable authority upon the present status of the

* Subsequent to the delivery of this lecture, new investigations in East Africa have cast serious doubt upon the validity of these finds.

problem of man's antiquity in the New World, the paleontologist, Alfred S. Romer, says:

> The association of man in America with certain fossil forms is unquestioned, and there is a growing body of evidence strongly suggesting his contemporaneity with a considerable number of mammalian types no longer living. Such contemporaneity, however, by no means indicates any remote geological antiquity for man on this continent, and there is at present almost no palaeontological evidence suggesting his presence here at a time earlier than that of the withdrawal of the last Pleistocene ice-sheet.[13]

The canny and conservative archeologist, N. C. Nelson,[14] is even more pessimistic and positive in reaching a similar conclusion.

Nevertheless, evidences suggesting a considerable antiquity of man in the New World keep cropping up, and each succeeding growth is tougher and harder to trample down. There is, for example, the case of Minnesota Man, who appears to have been a young lady who fell into a lake which preceded the postglacial Lake Agassiz, and whose remains, sealed under a concrete highway, were brought to light by the combined efforts of Jack Frost and a road-scraper. This young woman, although of an ordinarily modern appearance in most features, nevertheless possessed teeth and jaws of altogether exceptional size—quite outside of the range of civilized debutantes. Her doughty champion, my friend Professor A. E. Jenks, is now engaged with his colleagues in a definitive report upon her anatomical characteristics and the geological circumstances of the find. This discovery calls for consideration by a commission of impartial experts from every field of science concerned. Meanwhile we must not blackball Miss Minnesota, but rather put her on the waiting list.

If the recent discoveries in the Old World prove an Early Pleistocene existence of *Homo sapiens*—or morphologically modern man—it is no longer possible to discredit the geological antiquity of fossil American finds on the sole ground that they do not exhibit Neanderthaloid features or other morphological characteristics unmet in the recent American Indian. It is indeed conceivable that we, like the cheering Romans who remained on the safe side of the Tiber, presently may be impelled to shout "Back Aleš! Back Hrdlička! Back ere the ruin fall!"

What Races Are and How They Originate

Some of us less favored or more meagerly gifted physical anthropologists have neither fossil apes nor fossil men, but must content ourselves with the common or garden varieties of *Homo sapiens*. The study of race can occupy the liveliest intelligence, since race is no dead issue. It abides yesterday, to-day and forever.

At the onset of the twentieth century anthropology had barely shaken itself loose from spurious notions of race based upon language, geographical areas and national boundaries. Gradually there had become dominant a zoological conception of races as varieties, each characterized by the common possession of combinations of featural variations inherited from related ancestors. Race was the individual's less immediate physical heritage.

Here is no place to relate the ludicrous yet tragic history of the prostitution of the scientific conception of race to base political motives, to religious intolerance and to economic advantage. There can be no doubt, however, that progress in the scientific studies of human races has been obstructed by a vicious misuse of this important field of anthropological research. This perversion has gone on until the very term "race" has become a stench in the nostrils of most fair-minded and intelligent individuals. Nevertheless, in countries where liberty of speech, thought and action is still permissible, considerable progress in the analysis of race has been made during the past two and one-half decades.

Earlier classifications of race by physical criteria were largely based upon the variations of a few features, the hereditary transmission of which was naively and uncritically assumed.

In the early part of this century certain advances in biology began to influence and to stimulate the study of race. The first of these was the rediscovery of Mendel's law of heredity. When botanists and zoologists began to investigate inheritance in plants and animals, to tabulate the results of breeding experiments and to formulate rules whereby the transmission of physical features became predictable, the application of these findings to anthropological studies was imperative. The first effect of the genetic influence in physical anthropology was to force the student of race and of human heredity to develop a minute and exhaustive system for classifying immensurable morphological variations in man. For example, the rough categorization of hair color into light, medium and dark classes was obviously inadequate for any serious investigation of inheritance. Since it quickly became apparent that Mendel's laws of heredity concerned themselves with numerous small unit characters, it became necessary for the anthropologist to go beyond records of more or less composite dimensions, arbitrary indices and crude classifications of morphological features. He was now forced to

[13] Diamond Jenness, editor, "The American Aborigines"—Alfred S. Romer, "Pleistocene Vertebrates and their Bearing on the Problem of Human Antiquity in North America," p. 81, Toronto, 1933.

[14] Diamond Jenness, editor, "The American Aborigines"—N. C. Nelson, "The Antiquity of Man in America in the Light of Archaeology," p. 130, Toronto, 1933.

examine meticulously and to grade and measure as accurately as possible every variation of each physical feature which might be of potential value as a criterion of race.

Experimental genetics forced students of man, and particularly of race, to consider seriously, almost for the first time, whether the characters which were relied upon for racial classification were really heritable features or merely similar adaptations. In opposition to the genetic viewpoint there arose a powerful school of environmentalists, who were in revolt against Nordic propaganda and who subjected the supposed immutable hereditary criteria of race to a destructive criticism. Here we may recall the classic study of Professor Franz Boas, in which he demonstrated changes from the parental type in the American born offspring of European immigrants. For instance, the children of dolichocephalic aliens became perceptibly less long-headed, whereas those of brachycephalic antecedents suffered a diminution of relative head-breadth.[15] Apparently children changed their head-form with their birthplace. Somewhat later A. Ivanovsky recorded a series of modifications which took place in Russian populations, somewhat callously measured before a famine, during it and, if they were alive, after it. Besides the shrinkage of most bodily dimensions, a number of these hapless Russian groups showed a relatively greater decrease in head breadth than in head length, thus becoming somewhat more dolichocephalic or, literally, less fat-headed. However, this remarkable study also showed the resilience of head-form under environmental impact, since these famine-stricken Russians resumed their regular meals and their original cephalic indices almost simultaneously.[16]

Again, Arthur Thomson and L. H. Dudley Buxton offered evidence that the relative breadth of the nose (the nasal index) depends upon the environmental factors of moisture and humidity. Their theory was that a narrow nasal aperture is an adaptation to a cold dry climate, since it limits the intake of air to such amounts as may be sufficiently warmed in the nasal passages, thereby preventing the respiratory organs from being unduly chilled. Thus the fresh air-loving Englishman opens wide the window, but closes his nose to the merest crack. Conversely, broad nasal apertures are suitable for snuffing up generous drafts of warm moist air, and the Negro extensively ventilates his interior. These authors accordingly attempted to show that mean nasal index could be predicted from mean annual temperature.[17] This effort was moderately successful and seemed to show that the form of the nose was to some extent an adaptation to climate. A New Englander on this theory should develop automatically expanding and contracting nares, controlled by some somatic thermostat.

Environmentalist onslaughts upon racial criteria, however, have in no single instance terminated the usefulness of any standard measure of race differentiation. What the environmentalists have demonstrated is that over longer or shorter periods of time features which are hereditary in a stock are likely to be modified to some extent in response to functional needs or through sheer perversity. They have merely applied a harsh and well-deserved castigation to rabid hereditarians who have assumed, without taking the least pains to investigate the matter, that physical features in man are solely the result of germinal combinations.

Another notable advance in racial anthropology was again the indirect result of the interest in genetic studies stimulated by the Mendelians. Virtually nothing was known about the physical effects of race mixtures at the beginning of the century. There was indeed a certain mass of speculative and romantic literature concerning race mixture, wherein were enshrouded the casual observations of travelers, the partisan pronouncements of the prejudiced and the theoretical ruminations of scientists. But almost no contributions of appreciable scientific merit were existent, except the work of that great pioneer, Franz Boas,[18] upon the half-blood Indian and a small but valuable study of Edgar Thurston upon Eurasians.[19] In 1913 there appeared Eugen Fischer's[20] excellent monograph upon the crosses between Boers and Hottentots in South Africa—the first attempt, so far as I am aware, to examine in detail the familial inheritance of racial characters in a hybrid stock. Following this there came the work of Dunn and Tozzer[21] upon racial mixtures in Hawaii—a prelude to more extensive studies in this island group by Sullivan,[22] Wissler,[23] and Shapiro.[24] The last named also contributed a splendid monograph upon the Norfolk Islanders,

[15] Franz Boas, *Am. Anthrop.*, 14: 530–562, 1912.

[16] A. Ivanovsky, *Am. Jour. of Phys. Anthrop.*, VI: 331–353, 1923.

[17] A. Thomson and L. H. D. Buxton, *Journal of the Royal Anthropological Institute*, LIII: 92–123, 1923.

[18] Franz Boas, *Pop. Sci. Monthly*, XLV: 6, 761–770, October, 1894.

[19] Edgar Thurston, *Bull. of Madras Gov. Mus.*, II: 2, pp. 69–114, 1898.

[20] Eugen Fischer, "Die Rehobother Bastards und das Bastardierungs-problem beim Menchen," II Jena, 1913.

[21] L. C. Dunn and A. M. Tozzer, *Peabody Mus. Papers*, XI: 3, 1928.

[22] Sullivan, *Bishop Mus. Mem.*, XI: 105–257, Honolulu, 1930.

[23] Clark Wissler, *Bishop Mus. Mem.*, XI: 105–257, Honolulu, 1930.

[24] H. L. Shapiro, *Am. Mus. Papers*, XXXIII: 225–27?, New York, 1933; *Bishop Mus. Mem.*, XI: 1–106, Honolulu, 1929; *Nat. Hist.*, XXXI: 31–48, New York, 1931.

descendants of the mutineers of the warship *Bounty* and of Tahitians—a historic example of miscegenation in which current fiction has aroused a renewed interest. G. D. Williams[25] followed with a painstaking examination of the results of mixtures between Spanish and Maya Islands in Yucatan, Rodenwaldt[26] with a meticulous study of Dutch Kisarese hybrids in the Indo-Malayan region, while crosses between various European stocks with the Negro in the New World were investigated by Davenport and Steggerda,[27] Herskovits,[28] Day,[29] and others.

As a result of these and other studies of miscegenation we can now put forward certain generalizations, which of course may be subject to future emendation or possibly to contradiction. These may be stated briefly:

(1) Crossings between races which are physically widely diverse do not result in any diminution of fertility, either in the first filial generation or in their subsequently inbred offspring. On the contrary, miscegenation seems to be attended by an increased fecundity.

(2) No satisfactory evidence has been adduced in favor of the supposition that racial hybrids sprung from wide crosses are inferior in vigor or in vitality to the parent stocks which have produced them.

(3) The alleged occurrence of physical and mental disharmony in hybrids has not been substantiated by any considerable body of evidence. There is frequently a maladjustment of the hybrid population, but it is sociological and not biological.

(4) While it is clear that many morphological features are transmitted according to Mendelian laws of heredity, it is obvious that simple unit inheritance of morphological and indicial criteria of race does not apply. Unit characters are small and multiple for almost every feature. Segregation and dominance occur, but the genetic situation is usually so complicated that it can not be tested by the application of rules of Mendelian expectation.

Genetic analyses of race mixtures have also affected methods of racial classification and conclusions concerning racial origins. Indeed it now becomes clear that hybridization has played a leading rôle in race differentiation. Observation of the inheritance of racial features in contemporary wide crosses has taught us to identify stabilized hybrid combinations of features in the individual and has enabled us to dissect composite races. We must now admit that the majority of the great human groups which have been accorded racial classification are not the results of evolution acting upon pure inbred lines, but rather the end products of outbreeding followed by intensive inbreeding and selection. Indeed, even the noble Nordic race is not free from the suspicion of a bar sinister upon its escutcheon. It seems wholly possible that the Negro race alone can fling about the term "bastard" with an absolute certainty that it is not shying pebbles in a vitreous domicile.

Another notable advance in racial studies has been due to the development and application of biometric methods. The lion's share of the credit for this achievement must go to Professor Karl Pearson, the monarch of the statistical jungle whose hunting trail we humbler denizens follow at a respectful distance, despised as a pack of unmathematical hyenas, but nevertheless avidly devouring his kills.

In the pre-Pearsonian era almost all physical anthropologists were content to estimate the anthropometric status of any group principally from arrays of raw means of isolated characters. Little attention was paid to dispersion or variability and practically none at all to the adequacy of samples. The interdependence of variables was usually disregarded. Kindergarten arithmetic was generally thought to suffice.

Professor Pearson has invented many fine statistical tools whereby anthropometric series may be thoroughly analyzed. If some of us use them improperly in our ambitious ignorance, we, at any rate, accomplish more than we did with our bare hands. The fork is an admirable implement for table use, even if one insists upon picking one's teeth with it. The greatest boon of the biometric school to the anthropologist was the method of dealing with the sampling problem. Since it was discovered that most anthropometric characters are distributed in an approximately normal fashion, it became possible to utilize the mathematical properties of the normal curve to gauge the reliability of the constants of small samples. Now when an anthropologist wishes to determine whether the differences between two groups are statistically significant or merely due to chance, he can approach the task with some confidence. Other statistical devices have contributed in the transformation of physical anthropology from a more or less futile recording of unintelligible measurements to something approaching a mathematical science of analyzing biological data. It is of course true that some mathematically gifted persons, lacking a proper knowledge of anthropological objectives, have frittered away the pages of scientific journals, playing aimless and endless games with formulae and equations.

It would be hard to exaggerate the importance of modern mechanical inventions in facilitating anthro-

[25] G. D. Williams, *Peabody Mus. Papers*, XIII: 1, pp. 1–247, 1931.
[26] E. Rodenwaldt, "Die Mestizen auf Kisar," 1927.
[27] C. B. Davenport and M. Steggerda, Carnegie Inst. of Washington, Pub. No. 395, 1929.
[28] M. J. Herskovits, "The American Negro," pp. 3–82, 1928.
[29] C. B. Day, "A Study of Some Negro-White Families in the United States," pp. 1–126, 1932.

pometric studies. In the days of hand calculation no anthropologist with any foresight would attempt to gather data pertaining to really large groups of individuals, because he knew very well that the sheer drudgery of the arithmetic involved in the reduction of these data would preclude every possibility of a complete analysis. Therefore the wise virgins made brief and rapid forays into the field of investigation, making sure that they went no farther and no longer than the oil in their lamps would last. On the contrary, some foolish virgins found their lamps extinguished when they were still far afield. Now electric calculators have reduced the arithmetical labor to such an unbelievable extent that the anthropologist faces with complete equanimity series consisting of thousands of individuals, whereas previously he quailed at hundreds. Consequently modern anthropological investigations are both more extensive and more intensive than was possible in the pre-mechanical age, and the results are proportionately more reliable.

One of the defects of method in racial classification and racial analysis incident to lack of mechanical apparatus for the reduction of mass statistics was the practice of judging racial characters by means of isolated measurements and by percentages of observations taken singly. If an investigator found that the average stature of a group studied was tall, that a large proportion of the group had dark eyes and that the mean of the cephalic index was seventy-five, he was inclined to assume that the majority of individuals in his group were characterized by a combination of tall stature, dark eyes and dolichocephaly. Actually the assumption that mean group values of metric features and modal categories of variations of morphological characters are linked together in the majority of individuals is usually incorrect. This method has led to the setting up of fictitious racial types. It has resulted in erroneous racial classifications. Until a few years ago there was available no means of exploring actual combinations of racial criteria in large groups of individuals, except by an endless and maddening process of hand-sorting. Now, however, it is possible to utilize electric sorting and tabulating machines, whereby the data concerning each individual are punched into a single card, and thereafter any desired combination of characters, however intricate, may be selected and counted automatically with incredible rapidity. Service bureaus in large cities do this work at very reasonable rates. When the numerically adequate samples of each racial group, which are now being gathered over the world, are subjected to exhaustive analysis by the use of these mechanical devices, we may hope to establish definitive scientific racial classifications which will endure.

It should be clear to every thinking person, however, that until the physical delimitations of races are definitely determined, any attempt to study their psychological characteristics or their varying capacities for cultural achievement must be wholly futile. At present assertions of racial inequality and of racial equality are alike unscientific.

This brings me to the latter query of my subject "Whither *Homo sapiens*?" There can be no doubt that studies of races, groups or individuals which confine themselves purely to physical description and analysis are comparatively, if not absolutely, sterile. Is anything known of the cultural implications of physique either in the individual or in groups? In the past two decades a number of extensive researches have dealt with the problem of such correlations. Many growth studies of school children have shown that physical superiority is definitely associated with superior scholastic aptitude. Mental deficiency is commonly associated with inferior physique. In 1913 Charles Goring conclusively demonstrated that English criminals, as a group, are vastly inferior in physical development to the law-abiding population. My own weary researches upon the American criminal in ten states are even more decisive. While the complete results can not yet be divulged to a none too impatiently waiting public, it can be stated positively that the biological inferiority of the criminal is no less marked than his economic ineffectiveness and his general stupidity.

We are faced by the sinister necessity of ascertaining whether or no man's most benevolent cultural efforts—medical science and idealistic humanitarianism—are eating him alive by eliminating the evolutionary effect of natural selection. Natural selection is a sort of automatic surgery whereby malignant phylogenetic growths are excised. It is the most effective preventive of stock contagion, since it extirpates the infected.

On the whole, the physically well endowed are likely to have better mental equipment than constitutional inferiors. But it seems certain that one important effect of modern medical practice is to preserve the lives of the weak and the mentally unfit, thereby permitting them to reproduce more of their kind. Thus the average quality of the population is lowered. Medical science is virtually impotent to deal with mental disease or deficiency. It therefore patches up the bodily ills of the mentally diseased and insures their opportunity to perpetuate their taints.

One of the principal teachings of current religious and social philosophy is, in effect, that all human life is sacred and that man's highest mission is to preserve it, however worthless it may be. This well-intentioned humanitarianism forces us to expend more and more of our resources for the preservation and increase of

that part of our population which is least worthy of existence and to protect society from the results of its own irresponsible breeding.

We all admit that our social engine has stalled, and a succession of political, economic and sociological drivers have been pulling and pushing every movable gadget in a futile effort to make it start. May not a biological bystander suggest the possibility that some one has watered the gasoline?

It would be expedient to conclude this survey with an innocuous prophecy of the evolutionary future of man's wisdom teeth, little toes, head hair and other degenerating appurtenances. It would be inspiring to produce evidence that man's body is evolving into a perfect organism and that his mentality is growing apace like the national debt. Unfortunately, I am unaware of any marked improvement of man's evolutionary status since the end of the glacial period. On the other hand, distinctively regressive or degenerative trends, general to the contemporaneous human species, are possibly confined to a few features of the organism—perhaps notably the dentition. What we must avoid is a progressive deterioration of mankind as a result of the reckless and copious breeding of protected inferiors. We have not the knowledge to breed supermen, but we can limit the reproduction of criminals and mental defectives. Let us cease to delude ourselves with the belief that education, religion or other measures of social amelioration can transform base metal into gold. Public enemies must be destroyed—not reformed. We need a biological new deal which will segregate and sterilize the anti-social and the mentally unfit. Intelligent artificial selection should replace natural selection.

SCIENTIFIC EVENTS

BIRD SANCTUARIES IN NEW YORK CITY

THE Park Department of New York City has under consideration a plan presented by the National Association of Audubon Societies for preserving the remaining natural wild-life areas in the city by making them bird sanctuaries. The association, according to *The New York Times*, proposes to establish sanctuaries in five of the larger parks, and the department has agreed to consult the society in preparing plans for these parks and to follow its suggestions if possible. The new sanctuaries will be in addition to those already in operation in Central Park. Dr. Robert P. Allen is in charge of the plans of the association.

According to Mr. Allen, some wild fowl and song birds still nest in the city, but their numbers are decreasing every year as the parks and vacant areas are cleared and improved. It is proposed to fence off and keep unspoiled those areas still in a natural state. In addition he would plant various shrubs for ground cover and to provide food.

In Van Cortlandt Park it is hoped to have set aside the twenty-acre tract north of the boating lake, which has been a natural sanctuary for generations, although considerably reduced from its former size. It was here that last spring the rare glossy ibis was observed, and Virginia rail still nest there regularly. In addition to shrubs, wild rice and other marsh plants would be planted in this area.

In Queens it is proposed to fence and improve the existing protected area in Alley Pond Park, which includes a pond and about forty acres of upland, and to set aside the swamp area in Kissena Park as a second reservation for herons, ducks and other marsh birds.

In the New Springville Park sanctuary on Staten Island Mr. Allen suggests that a salt-water pond be created by damming up the marsh area. This would increase the size of the preserve to 100 acres and would provide the only nesting place in the city for salt-water birds. This tract also needs fencing and further planting.

In Brooklyn it is proposed that the pond on the Dyker Beach Park golf course be preserved as a sanctuary. Even under present conditions it is inhabited by rails, least bitterns, Florida gallinules and other water birds.

The Central Park sanctuaries established last year have proved to be a great success. A record number of birds was observed in Central Park this season. One hundred and thirty-two species were counted, compared with only one hundred and twenty-seven last year. The only birds that now nest regularly in the park are English sparrows, starlings, flickers, purple grackles, song sparrows and occasionally screech owls. It is proposed, if possible, to lay out nature trails, with every tree and shrub properly labelled. Mr. Allen considers that the Fifty-ninth Street lake is well adapted to water fowl and suggests the planting of more water plants in the park as an inducement for them to use it.

FIFTH ANNUAL FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

THE fifth annual meeting of the Field Conference of Pennsylvania Geologists was held at Philadelphia from May 31 through June 3. Headquarters were established at the Academy of Natural Sciences of Philadelphia, from which place all field trips started.

The local committee consisted of Professor E. H. Watson, of Bryn Mawr College, *chairman;* Samuel Gordon, of the Academy of Natural Sciences, *secretary;* Dr. B. L. Miller, of Lehigh University; Professor Frederick Ehrenfeld, of the University of Pennsylvania, and S. Herbert Hamilton, of the Atlantic Refining Company. The committee was assisted by other geologists from the U. S. Geological Survey, the DuPont Company, Bryn Mawr College and the University of Pennsylvania.

Registration and museum tours occupied the morning of the thirty-first, and in the afternoon the party divided into two groups for field trips. Trip A under Dr. Lincoln Dryden, of Bryn Mawr College, visited places of physiographic interest, chiefly southwest of Philadelphia, while Trip B, led by Mr. Gordon, paid attention to localities of mineralogic and petrologic interest near the city. On June 1 the entire conference joined in Trip C, an all-day excursion led by Dr. Watson. The party spent most of the time observing the crystalline rocks of the Piedmont north and west of Philadelphia. At localities of special interest, short lectures were delivered by authorities in the field, including Drs. F. Bascom, J. Gillson and D. Wyckoff. Excursion D on Sunday, June 2, was attended by the entire conference. Led by Dr. B. L. Miller, who was assisted by Drs. Watson, Dryden and E. T. Wherry, its chief objective was to observe the controversial area of the Chester Valley westward from Philadelphia, but other points of interest were the Valley Forge Cement Company's plant with newly installed flotation process, Valley Forge Park and exposures of the Triassic. On Monday a special excursion, Trip E, visited the Coastal Plain region of New Jersey. This trip was conducted by Professor Ehrenfeld and Dr. Henry B. Kümmel, state geologist of New Jersey.

On the evening of the thirty-first, the University of Pennsylvania tendered a complimentary smoker to the conference. In the unavoidable absence of President Gates, Dean Musser delivered the address of welcome. The annual dinner was scheduled for the evening of June 1. Dr. Gillson served as toastmaster. The dinner concluded with a business meeting.

The 1936 conference is to be held in conjunction with the members of the New York Geological Association, which has already accepted the Pennsylvania Conference's invitation to meet jointly in the anthracite fields. Therefore, a joint committee to consider the place and time of meeting and prepare the program and schedule of trips was appointed.

A total registration of 86 was recorded for the meetings this year with an actual attendance of at least a hundred, the largest number yet present. Besides Pennsylvanians from all parts of the Commonwealth, geologists attended from Massachusetts, New York, New Jersey, Delaware and the District of Columbia. The record number was due largely to the controversial nature of much of the geology, especially the structural relations and age determinations of the formations of the Chester Valley region, problems which have recently drawn considerable interest among geologists in the eastern part of the United States. Despite the size of the party and the necessity of moving a motorcade of 25 to 30 cars through the thickly settled Philadelphia district, the trips were handled without difficulty, thanks to a trained escort of the Pennsylvania State Highway Patrol. The efficiency of the local committee in caring for all details is greatly to be commended, especially the time and effort which its members spent in preparing a forty-three page guide booklet and arranging a detailed itinerary.

BRADFORD WILLARD,
Secretary-Treasurer

THE INTERNATIONAL ASTRONOMICAL UNION

THE fifth general assembly of the International Astronomical Union is meeting from July 9 to 17 in Paris under the presidency of Dr. Frank Schlesinger, director of the Yale University Observatory. Science Service reports that conferences will be held on plans for cooperative observations, questions of stellar notation and various special matters of international interest.

Astronomers from Soviet Russia will sit in the assembly for the first time, and representatives of the U.S.S.R. Academy of Sciences will tell of plans being made to observe the sun's total eclipse in 1936. Germany is not yet a member of the union, but many Germans have been invited in a "consultative" capacity. Some thirty other nations are to be represented. There will be an exhibition of astronomical documents and apparatus. The Astronomical Society of France on the evening of July 14, the national holiday in France, will tender a banquet on the top floor of the Eiffel Tower.

President Schlesinger will deliver the principal address. Other American astronomers who will attend include: Dr. W. S. Adams, director of Mt. Wilson Observatory; Dr. B. Boss, director of Dudley Observatory; Professor S. Boothroyd, Cornell University; Dr. D. Brouwer, Yale University; Professor E. W. Brown, Yale University; Dr. A. J. Cannon, Harvard College Observatory; Professor W. K. Green, Amherst College; Miss M. Harwood, director of Maria Mitchell Observatory; Captain J. F. Hellweg, superintendent of Naval Observatory; Professor F. C. Jordan, director of Allegheny Observatory; Dr. P. van de Kamp,

Leander McCormick Observatory; Professor M. Kovalenko, Swarthmore College; W. D. Lambert, U. S. Coast and Geodetic Survey; Dr. A. O. Leuschner, director of Students Observatory, University of California; Professor S. A. Mitchell, director of Leander McCormick Observatory; Rev. P. A. McNally, S.J., director of Georgetown College Observatory; J. Robertson, Naval Observatory; Dr. H. Shapley, director of Harvard College Observatory; Reverend M. Selga, S.J., Manila Observatory, Manila, P. I.; P. Sollenberger, Naval Observatory; Professor F. Slocum, Wesleyan University; Dr. A. van Maanen, Mt. Wilson Observatory.

BOTANY AT HARVARD UNIVERSITY

IN his address before the Alumni Association of Harvard University, President James Bryant Conant, in referring to the reorganization of the work in botany at the university, said:

> One of the most pressing problems that confronts us is how to bring the various parts of this University into closer contact with each other. If we are to realize all the potentialities which are contained in our eleven faculties and our more than a dozen museums, laboratories and research units, we must strive for a more unified effort in many fields. I am under no delusion that great results in such matters can be accomplished over night. But here and there we can make progress year by year. Take the situation in regard to botany, for example. We have extraordinary assets which we have accumulated over a period of years, thanks to the labors of such great figures as Asa Gray, John S. Farlow, Charles S. Sargent and Richard T. Fisher, and the generosity of many alumni and friends. These assets include the Arnold Arboretum, the Harvard Forest, the Gray Herbarium, the Farlow Herbarium, the Botanical Museum, the Botanic Garden, laboratories for botanical research in the Bussey Institution and in the new Biological Laboratory here in Cambridge. To correlate the activities of all these institutions is obviously of great importance. Professor Oakes Ames, chairman of the Council of Botanical Collections and supervisor of the Arnold Arboretum, has performed invaluable service in this matter and over a period of years has brought about an ever-increasing harmony of interests. He now wishes to be relieved of this administrative burden and we have been fortunate enough to persuade another distinguished botanist to take it over. Dr. Merrill, director of the Botanical Garden in New York, has been appointed professor of botany and administrator of botanical collections. Under his direction we may expect a still further development of our facilities for botanical research with each unit independent but each helping the other in every way possible.

Dr. Merrill is a member of a number of American and foreign societies. He is known for his work in the taxonomy and phytogeography of the Chinese, Malaysian, Philippine and Polynesian floras, having spent twenty-two years in that part of the world. Among other posts, he has held that of director of the Bureau of Science at Manila from 1919–1922, dean of the College of Agriculture of the University of California, 1923–1929; director of the California Botanical Garden, 1927–1929, and professor of botany at Columbia from 1930. In the same year he succeeded Dr. N. L. Britton as director of the New York Botanical Garden. Under Dr. Merrill's régime, the herbarium at the Botanical Garden, the second largest in the United States, has been catalogued, a majority of the specimens being filed with copies of the original descriptions, references and other significant data, thus applying the methods of the library to the herbarium.

Dr. Merrill is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Royal Asiatic Society, the Deutsche Botanische Gesellschaft, the Société Botanique de France and the Linnean Society of London. He is the author of numerous books and articles, particularly in systematic botany, and has been editor of various publications. During his active career he has described in excess of 3,000 new species of plants.

RECENT DEATHS

SERGIUS P. GRACE, assistant vice-president of the Bell Telephone Laboratories since 1928, died by suicide on June 23. Mr. Grace was fifty-nine years old.

DR. THOMAS MCCRAE, since 1912 professor of medicine at Jefferson Medical College, died on July 1, at the age of sixty-four years.

O. B. MARTIN, director of the agricultural extension service of the Agricultural and Mechanical College of Texas, died on June 30. He was sixty-three years old. Mr. Martin went to Texas in 1927 from Washington, where he had been director of extension work of the Department of Agriculture for the southern region, comprising the cotton-growing states.

J. T. CUNNINGHAM, the marine zoologist and biologist, of the London Hospital Medical College, died on June 5 at the age of seventy-six years.

SIR JAMES WATT, Scottish forestry expert, died on July 1 at the age of ninety-three years. He had an international reputation as a seedsman and had engaged in farming in Canada on a large scale. In 1900 he became a member of the Departmental Board of Agriculture on Seeds for the British Empire. Earlier he had been employed by the government to reforest the mountains in the Isle of Man.

DANIEL NICOL DUNLOP, a director of the British Electrical and Allied Manufacturers' Association and a founder of the World Power Conference, died on May 30, aged sixty-seven years.

SCIENTIFIC NOTES AND NEWS

DR. WALTER S. ADAMS, director of the Mount Wilson Observatory, has been elected a correspondent of the French Academy of Sciences.

PROFESSOR ROSS G. HARRISON, Sterling professor of biology at Yale University, has been elected a member of the Royal Scientific Society of Uppsala, Sweden.

AT a meeting of the Royal Society, London, on June 20, Walter Elliot, minister of agriculture and fisheries, was elected a fellow of the society under the special statute which permits the election of "persons who have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the society."

PROFESSOR ROBERT GRANT AITKEN, who succeeded Dr. W. W. Campbell as director of the Lick Observatory in 1930, retired on July 1. Dr. Aitken was appointed assistant astronomer at the observatory in 1895, became astronomer in 1907 and associate director in 1923. He is succeeded by Dr. W. H. Wright, who joined the staff of the observatory as assistant astronomer in 1897 and who has held the rank of astronomer since 1908. Dr. Aitken's permanent address will be Berkeley, Calif.

ON the occasion of his retirement after fifteen years' service, an oil portrait of Dr. Milton C. Winternitz, dean of Yale University School of Medicine, was presented to the school by the student body at a meeting on June 17 of the Association of Yale Alumni in Medicine. Dr. Stanhope Bayne-Jones, who succeeds Dr. Winternitz as dean, accepted the portrait in behalf of the school and of the university. Professor C.-E. A. Winslow was among the speakers.

DR. EDWARD A. PREBLE, senior biologist of the Bureau of Biological Survey of the U. S. Department of Agriculture, retired on June 30, having been a member of the survey since 1892. At a farewell gathering on June 28, Dr. Preble was honored by his associates in the bureau and was presented with a testimonial brochure and the complete works of Henry David Thoreau, John Burroughs and John Muir.

AT the commencement exercises of the University of Minnesota, Dr. W. J. Mayo and Dr. C. H. Mayo were awarded the honorary degree of doctor of laws. At the alumni dinner held immediately before the commencement exercises, Dr. W. J. Mayo was presented with a scroll for distinguished service as a member of the Board of Regents since 1907.

THE degree of doctor of laws was conferred on Dr. Madison Bentley, Sage professor of psychology at Cornell University, at the annual commencement of the University of Nebraska, from which he graduated in 1895.

BALDWIN-WALLACE COLLEGE, Berea, Ohio, has conferred the degree of doctor of science on Professor W. B. Herms, professor of parasitology and chief entomologist in the experiment station of the University of California. Dr. Herms graduated from Baldwin-Wallace College in 1902.

DR. RAFAEL RODRIGUEZ MOLINA, of the department of medical zoology of the School of Tropical Medicine, San Juan, Puerto Rico, received the degree of doctor of medicine at the commencement exercises of Columbia University on June 4.

THE Lamme Medal, given for "meritorious achievement in development of electrical appliances for machines," was awarded to Henry Ellis Warren, president of the Warren Telechron Company, at the recent Ithaca meeting of the American Institute of Electrical Engineers. The award was given for his work in utilizing commercial alternating current for the purpose of timekeeping, and for the invention of a new electric motor and its appliance by power companies for measuring and regulating frequencies.

AT the annual meeting of the American Society of Clinical Pathologists the following awards were made: The Ward Burdick award to Dr. John A. Kolmer, for his contribution in the field of clinical pathology; the gold medal on scientific exhibits to Dr. Russell Haden, Cleveland, Ohio; the silver medal to Dr. Anna M. Young and her associates, Dr. M. B. Cohen and Dr. B. S. Kline, Cleveland, Ohio; and an honorable mention to Dr. E. von Haam, of New Orleans, La. Officers were elected as follows: *President-elect,* Dr. Roy R. Kracke, Emory University, Georgia; *Vice-president,* Dr. R. A. Kilduffe, Atlantic City; *Executive Committee,* Dr. F. H. Lamb, Davenport, Iowa; Dr. L. W. Larson, Bismarck, N. D.; *Board of Censors,* Dr. O. W. Lohr, Saginaw, Mich.; Dr. I. A. Nelson, Tulsa, Okla.; *Board of Registry of Technicians,* Dr. Philip Hillkowitz, Denver; Dr. Kano Ikeda, St. Paul.

THE fifth annual meeting of the American Malacological Union was held in the Buffalo Museum of Science on June 27, 28 and 29. The following members of the council were elected for the ensuing year: Mrs. Ida S. Oldroyd, Stanford University, *honorary president;* Calvin Goodrich, University of Michigan, *president;* Joshua L. Baily, Jr., San Diego, *vice-president;* Norman W. Lermond, Knox Academy of Arts and Science, Thomaston, Maine, *corresponding secretary;* Mrs. Imogene C. Robertson, Buffalo Museum of Sci-

ence, *financial secretary;* Henry A. Pilsbry, Philadelphia Academy of Science; Paul Bartsch, United States National Museum; Junius Henderson, University of Colorado Museum; and William J. Clench, Museum of Comparative Zoology, Cambridge, Mass.

DR. FRANCIS P. GARVAN has been elected president of the Farm Chemurgic Council, recently established in Chicago. The council has at its object the use of farm products in industry.

AT a meeting of the senate of the University of London, held on June 12, with the vice-chancellor, Professor L. N. G. Filon, in the chair, H. L. Eason, superintendent and senior ophthalmic surgeon of Guy's Hospital, was elected vice-chancellor for the year 1935–36.

DR. C. S. MYERS, principal of the National Institute of Industrial Psychology, London, and formerly a fellow, has been elected an honorary fellow of Gonville and Caius College, Cambridge.

DR. WILLIAM S. MIDDLETON, professor of medicine in the Medical School of the University of Wisconsin, has been appointed dean to succeed Dr. Charles R. Bardeen, who died on June 12. Dr. Middleton was elected in May president of the American Association of the History of Medicine.

DR. WILLIAM SPENCER CARTER, who was dean of the University of Texas School of Medicine, at Galveston, from 1903 to 1923, when he became associate director of the Division of Medical Sciences of the Rockefeller Foundation, will resume the office of dean at the University of Texas to succeed the late Dr. George E. Bethel.

DR. SANFORD VINCENT LARKEY has been appointed librarian of the Welch Medical Library at the Johns Hopkins Medical School, to succeed Dr. Fielding H. Garrison, who died in April. Dr. Larkey will assume his new work next fall. Since 1930 he has been the librarian of the University of California Medical School Library and assistant professor of medical history in the University of California.

DR. O. N. ALLEN, of the University of Hawaii, who has been recently promoted from the rank of assistant professor of bacteriology and plant pathology to that of associate professor, will serve as head of the department of botany in the absence of Dr. Harold St. John, who is away on Sabbatical leave.

THE following retirements have been announced by the University of Glasgow: Dr. Ludwig Becker, professor of astronomy since 1893; Dr. T. H. Bryce, since 1909 professor of anatomy, who has been continuously on the staff of the university since 1892; Professor Peter Paterson, of the St. Mungo chair of surgery at the Royal Infirmary since 1924, and Sir Andrew Hunter, Gardner professor of physiological chemistry since 1929. Dr. George M. Wishart, at present lecturer in physiology, has been appointed to the Gardner chair, in succession to Professor Hunter.

C. G. ANDERSON, a member of the teaching staff of the London School of Hygiene and Tropical Medicine, has been appointed first Lewis Cameron teaching fellow in the department of bacteriology in the University of Edinburgh.

THE Institute of Medicine of Chicago announces that two Jessie Horton Koessler fellowships of $500 each for the aid of research in biochemistry, physiology, bacteriology or pathology have been awarded for the year beginning July 1, 1935; one to Robert A. Bussabarger, M.S., Northwestern University, 1935, for work on "Hematological Studies on Gastrectomized Animals" in association with Professor A. C. Ivy, at Northwestern University Medical School; the other to Dr. Clayton G. Loosli for his investigation of "Lung Phagocytes in Experimental Pneumonia" under the direction of Professor O. H. Robertson, of the department of medicine at the University of Chicago.

T. PAUL WILCOX, of Cheyenne, Wyo., has been appointed U. S. Commissioner for Yellowstone Park. He will succeed Colonel J. W. Meldrum, who has been commissioner for forty years and who is now ninety-three years old.

MISS ELLEN EDDY SHAW, curator of elementary instruction of the Brooklyn Botanic Garden, has been chosen to represent the Brooklyn Botanic Garden as a delegate to the sixth International Botanical Congress at Amsterdam.

DR. ALFRED N. RICHARDS, professor of pharmacology in the School of Medicine of the University of Pennsylvania, on whom the doctorate of laws will be conferred on July 17 by the University of Edinburgh, sailed for Scotland on July 3.

DR. TRUMAN MICHELSON, of the Bureau of American Ethnology, has been awarded a grant by the American Council of Learned Societies to make a linguistic map of the territories adjacent to James Bay and Hudson Bay. He will leave soon on his journey northward.

THE National Research Council has recently made a grant to Dr. A. B. Stout for travel expenses and technical assistance in connection with his study of seedlessness in grapes. Dr. Stout devoted the latter half of June to this work at the Agricultural Experiment Station at Geneva, N. Y.

DR. FRANK M. CASTO, dean of the School of Dentistry of Western Reserve University and president of

the American Dental Association, will go to Europe late in July to take part in the dedication of two of the five dental clinics for children built in various places in Europe, for which the late George Eastman gave five million dollars. On August 2 he will present the Eastman Clinic in Brussels to Belgium, the King and Queen formally accepting the building, and on August 11 he will officiate at the dedication of the Children's Clinic at Stockholm. Dr. Casto also plans to attend the meeting of the International Dental Federation in Brussels and the meeting of the National Dental Association of Belgium.

THE Pennsylvania Academy of Science will meet on August 9 and 10 at Stroudsburg. Headquarters will be established at Hotel Fenner, East Stroudsburg. A botanical field trip will leave Tannersville P. O. at 2 P. M. on August 9, and a geological field trip will start from the Stroudsburg State Teachers College at 9 A. M. on August 10.

THE opening of the new Museum of Practical Geology, South Kensington, and the celebrations of the centenary of the Geological Survey of Great Britain were held on July 3 and 4. According to plans previously announced, the opening ceremony was performed by H.R.H. the Duke of York, and the director of the Geological Survey, Sir John Flett, delivered an address on July 4 on the history and functions of the museum. Several geological excursions were arranged to follow the celebrations, and delegates had the opportunity of studying, under expert guidance, the Isle of Wight and mainland opposite, the Wealden district, South Wales and Bristol, or Edinburgh and the surrounding country.

THE "Floating Congress" of the Pan American Medical Association, composed of physicians and surgeons from North and South America, sailed on June 30 for Rio de Janeiro with several stop-overs *en route*. Three hundred physicians from the United States were in the party. Central and South American physicians will join the cruise at various points. The medical activities of the voyage will be divided into seventeen sections, representing all branches of medicine. The Brazilian medical profession has arranged scientific sessions at Rio de Janeiro and São Paulo with special exhibits at the Oswaldo Cruz Institute of Tropical Medicine and at the São Paulo University with its Institute Sero-Therepeutico.

DR. CH. MARIE, general secretary of the Annual Table of Constants, writes: "The last conference of the International Union of Chemistry, held in April, 1934, in Madrid, eager to help the committee on the Annual Table of Constants to go on with the work, had agreed to transfer to the committee an important part of the funds of which the union disposes. This decision was voted unanimously by the union's executive in Paris in October last and was confirmed by national organizations representing the various countries at the union (*e.g.*, Verband Deutscher Chemischer Vereine, representing Germany; Comité National Belge de Chimie, representing Belgium; National Research Council, Division of Chemistry, representing the United States, etc.). The sum thus put at the disposal of the committee on the Annual Table of Constants is 150,000 francs. The large amount shows the interest which the international chemical circles attach to the continuation of the table. This sum will be used up for the printing of the index of the second series (Vol. VI to X—1923–1930), now ready at the editorial office. In return for this gift the committee on the Annual Table of Constants will put at the disposal of the chemical organizations adhering to the union a certain number of complete sets. This number and the mode of their distribution are to be established shortly."

To correct any misimpression which the item in the May 31 issue of SCIENCE may have created, the University of Cincinnati states that the work of the Basic Science Research Laboratory is to be continued, proceeding in accordance with the original plan of coordinated fundamental research in the field of the natural sciences.

AMONG the appropriations to be expended in New York City by the National Works Administration is the sum of $144,000 for repairs and improvements at the New York Botanical Garden.

A NATIONAL health inventory, with special emphasis on chronic diseases and physical impairments, has been requested by the Public Health Service in filing an application for $3,450,000 from the work relief fund. The survey would be conducted in fifty cities, to be selected later. The proposed study would cover the following: (1) A house to house canvass to obtain records of the prevalence of chronic diseases and illnesses of long duration in sample groupings of the general population of various income levels. (2) Physical examinations by physicians supplemented by available hospital records for a smaller sample of the surveyed persons to evaluate the accuracy of the canvass reports. (3) A survey of medical facilities for the care of the sick, with special reference to the chronic diseases. (4) A fourth phase is contemplated as a part of the regular research of the Public Health Service, including an intensive study extending over several years of the importance and effect of given chronic ailments on the capacity of the patient and family to remain self-supporting and in other respects to carry on as a useful member of society.

DISCUSSION

THE PROBLEM OF EARTHQUAKE PREDICTION

CORRELATIONS between the occurrence of deep and shallow focus earthquakes presented by the writer at the Easter meeting of the American Geophysical Union have been interpreted in the public press[1] as a hint to earthquake forecasts. It has, however, to be said that our present knowledge of the phenomena of earthquakes does not permit any prediction of location and time of occurrence of a major earthquake with scientific precision.

Such a statement is certainly unsatisfactory, and it seems to be very necessary to discuss this matter, considering all the facts. We know that earthquakes are in many regions of the world an ever-impending menace to life and property. We may estimate the average number of people annually killed by earthquakes to be about 40,000. Such a number compares almost with the number of men killed in wars if we consider that major wars occur only three or four times in one century. People make frantic efforts to avoid wars, arrange costly conferences and maintain large international bodies for that purpose. All other natural and environmental dangers for human beings are fought with all the intelligence and means we possess. A large army of physicians fights diseases, which in earlier times were taken as acts of God and insuperable to mankind. Many large research institutions sharpen the weapons of these physicians in their fight. In the case of earthquakes, on the contrary, we accept the situation as our ancestors did, as inevitable fate. It is certainly true that we can not prevent them, but it is also true that an effective earthquake forecast system could insure against the worst consequences of quakes, namely, losses of life. The number of scientists and institutions engaged in research to create such a system is exceedingly small. We have perhaps some 400 seismologists in the world and about the same number of earthquake observation stations. The majority of these experts, however, concentrate their efforts on questions which are far from the problem of earthquake occurrence. The research on earthquake wave-velocities and similar questions is their main target, firstly, because the economic results of such research in application to geophysical prospecting are uncontestable, and, secondly, as many believe that it is futile to make an attempt to attack the question of forecasting earthquakes. The fields of earthquake-geography-and-geology as well as the field of earthquake-statistics, which may pave the way to the prediction of these disasters, are obsolete and only a very small number of people, certainly not exceeding 50 in the whole world, are more or less active in these fields. What we need is first of all a more complete survey of earthquake occurrence. Our best observational statistics go back to prewar-times, when A. Sieberg[2] numbered 9,000 earthquakes of all kinds per year, while other investigators believe to-day that there might be as many as 40,000 annually.[3] These numerical values and their geographic distribution have to be much more closely surveyed than heretofore.[4] But besides these surveys which would base an earthquake forecast on a probability extrapolation of statistical data, we have to investigate into the few merely physical phenomena which supposedly are forerunners of earthquakes. These are the earth tiltings, which occur within some months prior to major earthquakes, as observed on Mt. Tukuba;[5] furthermore, the occurrence of gravity changes as observed by Tomaschek and Schaffernicht to precede earthquakes by several hours, and the appearance of electromagnetic wave disturbances which were recently discussed by V. Piatti.[6] All these lines have to be followed up to prove whether they enable us to forecast earthquakes.

Summarizing, it has to be said that we have to admit "ignoramus," but there is no reason to believe in "ignorabimus," and the only conclusion which we have to draw is that more research is needed to attack the problem of earthquake prediction successfully.

H. LANDSBERG

SCHOOL OF MINERAL INDUSTRIES
STATE COLLEGE, PA.

[1] See SCIENCE, 81: 2105, supplement p. 11, 1935.

[2] A. Sieberg, "Erdbebengeologie," in B. Gutenberg's Lehrbuch d. Geophysik, Berlin, 1929, p. 172.

[3] Wm. Bowie, *Jour. Wash. Acad.*, 21: 103–175, 1931.

[4] N. H. Heck, *Geographical Review*, 25: 125–130, 1935.

[5] W. Inouye and T. Sugiyama, *Bull. Earthquake Res. Inst.*, 8: 362, 1930.

[6] V. Piatti, *Bollet. Soc. Sismol. Ital.*, 33: 22–42, 1935.

THE WORD "ALLELE"

FOLLOWING the lead of Johannsen, who contributed so much to brevity and precision in genetical terminology, the Batesonian term "allelomorph" is being rapidly replaced by the word "allele." So far as the writer is aware, this abbreviated form was used in English for the first time in a paper prepared by the undersigned for the Fifth International Genetics Congress, held in Berlin in September, 1927.

With the beginning of the current volume of *Genetics*, the editorial board of that journal officially adopted *allele* and its derivatives *allelic* and *allelism* as standard usage for articles published in its pages.

In certain recent articles on Drosophila genetics, published in other journals, the word appears in the form "allel," which is not correct philologically for use in English. The purpose of the present note is to urge

geneticists to standardize the word as promptly as possible by conforming to the proper spelling and pronunciation, ăl-lēle′. The word comes into English by way of the German "Allel" (pronounced äl-lāil′) the accent on the second syllable being appropriate only if the vowel in that syllable be long, as it is in the German and should be in the English. The Greek from which the word is ultimately derived is in harmony with this form, for ἀλλήλων (= of one another, from ἄλλος, other) has the long ē (eta) and the accent on the second syllable.

The normal accent for an English substantive with the spelling "allel" would be on the first syllable, ăl′lel (*cf.* Ma′bel, reb′el, etc.). To throw the accent on the second syllable while retaining the short sound of the vowel in that syllable would require the addition of another l or le (*cf.* rebellious). It is not difficult to find exceptions to these rules, in English, but there is no good reason for *making* exceptions when new words are being launched, and less reason for converting a word which has been used initially in its correct form, to a form which contravenes the normal rules of orthography.

The words "gene" and "clone" have finally won their way to uniform usage, and it is to be hoped that "allele" will reach the same status of uniformity and philological correctness with as little delay as possible. The same principles are involved in all three words.

GEO. H. SHULL
PRINCETON UNIVERSITY

GERMAN PERIODICALS AGAIN

As the chairman of the American Library Association committee on German periodicals the undersigned spent ten days in Germany in May conferring with a committee of the Börsenverein and with various German officials. As a result of these conversations, he was authorized to make the following statement (translated):

I am authorized to make the following statement:

A high authority in the German government has informed me that it is the present policy of the German government to reduce substantially the export prices of books and periodicals in order to ameliorate in so far as possible the difficulties which foreign libraries have experienced through depressed currencies in the procuring of German literature. The definite plan and methods will be made known before June 20, 1935.

On June 20 a cable was received from Dr. Hoevel of the Propaganda Ministerium which reads as follows (translated):

"The foreign prices of German books and periodicals for libraries will be reduced 25 per cent. effective about August first, 1935.—Doctor Hoevel."

The following resolution was adopted by the American Library Association at the closing meeting on June 29:

RESOLVED:

. . . Be it further resolved that this Association endorse the resolution passed by the College and Reference Section and express to the German government its appreciation of the action of the government in effecting a reduction of 25% in the export prices of books and periodicals for libraries. Be it further resolved, that the Secretary be instructed to inform the German government of this action.

The basis of the disagreement between American libraries and German publishers rests upon the method of publication in Germany, which differs from that of most other countries. The publication of scientific books and periodicals generally is endowed to some extent through societies and through university presses. The attempts of the Engineering Societies, the American Mathematical Society, the British chemical societies and other organizations to raise funds for the endowment of scientific publications are well known. There are no endowments left in Germany owing to the depreciation of the currency a number of years ago. Therefore, the publication of scientific books and periodicals must be either self-supporting or subsidized by the government.

Apparently the German government recognizes the difficulties in the situation. The final solution of the problems caused by present-day difficulties in international trade in general and by two divergent methods of scientific publishing in particular is neither simple nor clear, but at least some very decided progress has been made, thanks to this friendly action of the German government.

CHARLES H. BROWN
Chairman A. L. A. Committee on German Periodicals
IOWA STATE COLLEGE LIBRARY

THE BRITISH GUIANA EXPEDITION

WE are preparing to sail to conduct important ethnological and archeological research among the isolated aborigines of the remote Rupununi District of British Guiana before the impending colonization of the region, by the Colonial Government, destroys forever these primitive American Indian cultures.

This is a fully accredited scientific expedition sanctioned by the U. S. Department of State and authorized by the British Guiana Government.

Owing to the character of the work we shall operate radially from a comfortably established Base Camp and Field Laboratory some four hundred miles in the interior and I should like to extend an invitation through the pages of SCIENCE to qualified students in

all fields of natural history who might wish to take advantage of our organized expeditionary research in this region.

The New York Times has equipped the expedition with code radio transmitting and receiving apparatus, with which daily communications, news dispatches, etc., will be released from the base camp. The expedition is electrically equipped to provide for unusual field comforts and laboratory facilities and should offer extremely pleasant conditions for extensive studies of a practically unknown area.

While the expedition is essentially ethnological in character, it is my desire to increase the scope of scientific accomplishments while in the field by adding to the personnel such scientific members as may be qualified to contribute their bare transportation and living expenses, which are estimated at $1,250.00 for a full interval (New York to New York) of six months.

Supplementary field activities will include: (a) The collection of fine-grained geological specimens for Massachusetts Institute of Technology, Department of Geology, for time relation research. (b) A specimen of the rare, landlocked *Arapaima gigas*, a fifteen-foot, five hundred pound fresh-water fish, is to be secured for the American Museum of Natural History. (c) Geographical data will be filed with the American Geographical Society. This will include the exploration of Mt. Roraima, popularly known through Conan Doyle's fictional extravaganza as the "Lost World." (d) An experiment will be conducted to determine the effect of a controlled diet of modern prepared foods on the physical development of a selected group of primitive children.

All members of the expedition will be entirely free to devote their full time to their respective interests. They will be at liberty to write and to lecture on their specific subjects upon the return of the expedition and may equip themselves with both still and moving picture cameras for this purpose.

Inquiries and applications should be directed without delay to the headquarters of the expedition at Essex House, 160 Central Park South, New York City.

The expedition is thoroughly equipped for the general maintenance of the health of the party, but applicants will be required to provide health certificates attesting their physical ability to withstand the rigors of tropical life.

R. STUART MURRAY,
Leader, British Guiana Expedition, 1935

SCIENCE FOR THE GENERAL PUBLIC

ALLOW me to amend Waldemar Kaempffert's contention that "if we had a public adequately educated in science it would not be necessary . . . to resort to the literary devices of the primary school reader . . ." (SCIENCE, June 28, p. 640). The average intelligence and comprehension of the readers of our daily papers are, I find, far higher than the editors of those dailies presume.

And allow me to amend Howard W. Blakeslee's earlier contention that scientists will get more newspaper attention by using emotion-laden phraseology (SCIENCE, June 14, p. 591). Rather, scientists will keep the respectful attention of the general public (1) by always presenting their ideas clearly, and (2) by pointing to the significance of their work, with an evaluation *ad hominem* where at all possible.

MYRON WEISS
TIME, THE WEEKLY
NEWSMAGAZINE,
NEW YORK AND CHICAGO

SCIENTIFIC BOOKS

DE GENERATIONE

A History of Embryology. By JOSEPH NEEDHAM, Sc.D. Cambridge, at the University Press: New York, The Macmillan Company, 1934. xviii + 274 pp. 40 figs. Price, $4.00.

THIS is a second edition, somewhat enlarged and revised, of the author's historical introduction to his 3-volume "Chemical Embryology" of 1931. The detached chapters, at a lower price, are thus more readily available, which is fortunate, for they make a very serviceable book. Unauspiciously it begins with "Embryology in Antiquity: I. Indian Antiquity"—two pages illustrated solely by the nondescript painting on a recent New Guinea door (de Clercq, 1893). The main text is here unchanged, but footnotes and references have been added. Dr. Needham's reading-list, at the end of the volume, is a long one (35 pages) and there are few historians who will not find in it new and enticing titles. "Egyptian Antiquity" follows, with added material. There are figures of an ancient standard, borne before the king in his jubilee festival, representing no one knows what. But Seligman and Murray consider this bilobed object, with its cord or streamer, to be a perfect image of an afterbirth. Folklore on that topic—"reverence for the umbilical cord"—is followed by an account of primitive incubators, with "a very beautiful hymn" by a king of Egypt on the hatching of the bird. "Hellenic Antiquity" is almost as briefly considered, after which the reader encounters the heading, already contradicted, "Hippocrates: the Beginning of Observation."

Dr. Bruno Bloch in his scholarly essay "Die ge-

schichtlichen Grundlagen der Embryologie bis auf Harvey" (Abh. d. Kaiserl. Leop.-Carol. Akad., 1904) has reported how the unknown author of the Hippocratic *De natura pueri* gave directions for placing twenty or more eggs under a hen or two, so that by breaking open an egg every day one could observe, as he had done, the progressive development of the chick; and how Aldrovandi, on reading this account more than fifteen centuries later, proceeded to do just that, stimulating his pupil Coiter, and their younger contemporary Fabricius, to productive observations. Riolan also avers that the example of Hippocrates and Aristotle was followed by Aldrovandi, Coiter and Fabricius. In the interim there were many fumbling writers, and eminent physicians, theologians, artists and poets who adverted to the mystery of development. Patiently Dr. Needham records their slender contributions and futile opinions. With St. Hildegard, hailed by admirers as "die erste deutsche Naturforscherin und Ärztin," he thinks that "embryology touched, perhaps, its low-water mark." She thought that the stupid, feeble and useless elements of humanity were the less firmly curdled cheeses. But with Albertus "the new spirit of investigation leapt up into being." Like Aristotle "he produced biological work with, as it were, no antecedents." Averaged with Dr. Bloch's comment that "Albertus' embryology is throughout purely a work of compilation, lacking independence—an extract from Aristotle, modified in some parts through Galen and the Arabic sources," one may fairly estimate the contribution of the only anatomist who is now a full-fledged saint.

Leonardo is described as "the father of embryology regarded as an exact science." From Leonardo's notebook Dr. Needham selects a page of drawings of consummate art, and the memorandum that in every nine months, beginning with conception, increase in size diminishes till man has come to his full height. "One almost expects to see Leonardo exemplify his words with a graph until one remembers with a shock that he lived two centuries before Descartes, and five before Minot," whereupon Dr. Needham inserts as Fig. 9 Minot's graph in appropriate illustration. Such correlation of Leonardo and Minot has more basis than the finding of axial gradients "deep down in the mind of Aristotle," from which emerged also "the first reference to enzyme action."

In stating that Vesalius "took hardly any interest in fetal development" Dr. Needham declares him "the greatest anatomist of any age." Thus Vesalius, as usual, is not underestimated; nor Stensen, said to be "to all intents and purposes the founder of geology." The comment that Fallopius "must be mentioned as the discoverer of the organs which bear his name" may be compared with a preceding statement that "Herophilus described the Fallopian tubes." Fabricius fares badly. Dr. Needham does not agree with *Carolo Singer temporum nostrorum Erasmo eruditissimo* when the latter writes that Fabricius "elevated Embryology at one bound into an independent science." Unconsciously, however, Dr. Needham pays tribute to Fabricius. For in discussing Walter Needham he declares that his namesake's book is important "because it contains the first practical instructions for dissections of embryos (see Fig. 24)." The figure in question the elder Needham purloined from Fabricius, and he uses it also in his amusing attempt to draw a fetal horse from memory. But there are more serious matters.

The account of Malpighi's studies is inadequate and misleading. Under the microscope Malpighi first saw the central nervous system arising as a furrow in the skin, closing off as a tube, and expanding in a series of vesicles to form the brain. This familiar but momentous observation is not mentioned. The heart, at first a straight tube, coils in a precise manner which Malpighi clearly figured; but how from such a structure the four-chambered adult heart arose remained to him a mystery, and reasonably so. Instead of references to these and other basic morphological observations, we read that Malpighi "appears to have been anticipated as regards the first description of the chick's heart pulsating in colourless blood by Henry Power, M.D.," with a longer quotation from Dr. Power's delightful but relatively superficial book, than anything taken from Malpighi. Dr. Needham is interested in Malpighi's inference that organization is present in the egg at the outset. "Yet Malpighi's view was much more sensible than many which succeeded it," is a patronizing comment; and there are scattered references in the following pages to "the error of Malpighi," and "Malpighi's unfortunate experiments." Unable to draw, though having so much to represent, Malpighi produced some of the ugliest sketches known, though Dr. Needham comments, in all sincerity, "the plates . . . are beautiful." He continues—"It is interesting to note that Malpighi could not have done his work without Harvey whose name he mentions on his first page." Malpighi, in reporting his study "On the formation of the chick in the egg" to the Royal Society in London, writes politely and modestly—"Many have sweated in this research, eminent among whom is your immortal Harvey, whose finished observations so enlighten the world that my labors, especially, shrink into insignificance." That is not the judgment of posterity!

Similarly, Leeuwenhoek is introduced casually, Sir Thomas Browne reporting to his son,—"Here are some

things remarkable. . . . It may bee worth your reading." Libelous is the comment,—"the time-killing dilettante, almost philatelic, quality of Leeuwenhoek's investigations is, as Becking says, too obvious to be overlooked." But Leeuwenhoek has been vindicated by Dobell, and the reviewer recalls the session of the American Association at which Dr. Welch read passage after passage from Dobell's new book until reluctant adjournment near midnight. Dr. Needham says "Dobell's book on Leeuwenhoek, though marred by certain lapses of taste, is probably the most considerable and ingenious study of any seventeenth century biologist extant."

Embryology in the eighteenth century, with which this history concludes, is no climax. There are indeed Haller, Wolff, Buffon and Réaumur with his incubators, but "he nowhere gives any indication of his percentage hatch." (Après avoir vû naître des poulets de plus de trois quarts des œufs d'une couvée, etc., Réaumur, 1749, T. 1, p. 256). The fundamental questions remain unsolved while the observational and experimental data accumulate. Dr. Needham, in his conclusions, presents the limiting factors in a diagram. He has written an excellent book, attempting to clear his own mind, teased with the problems of teleology and the final cause.

That he writes as an Englishman and a chemist is clear from his selection of portraits to illustrate the history of embryology till 1815. William Harvey is the frontispiece; Coiter, fortunately, in excellent full page half-tone; and Leeuwenhoek, but no Malpighi; Robert Boyle, Sir Kenelm Digby, Sir Thomas Browne and his wife Dorothy; with smaller line drawings of De Graaf, Nathaniel Highmore and a group vignette including Buffon to complete the list. English also in his spelling *foetus*, sanctioned by the Oxford Dictionary, which contains this entry:

Latin, *fetus*, incorrectly written *fœtus*. The etymologically preferable spelling with *e* in this word and its cognates is adopted as the standard form in some recent Dicts., but in actual use is almost unknown.

Not so in America! The incorrect diphthong appearing several times on sundry pages is an unnecessary blemish in a book so commendable.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MEETING OF THE SOUTHWESTERN DIVISION

THE fifteenth annual meeting of the Southwestern Division and associated societies was held in Santa Fé, New Mexico, from April 29 to May 2, 1935, with the Laboratory of Anthropology, the Museum of New Mexico and the School of American Research as the host institutions. The meeting was the largest in the history of the division, with 220 registrants and 142 scientific papers, and the local committee, under the chairmanship of Jesse L. Nusbaum, director of the Laboratory of Anthropology, planned especially well for the smooth and efficient running of the meeting. The New Mexico Public Health Association met with the division, holding its own sessions for papers, and six other organizations, including the Ecological Society of America, were officially represented on the program, especially in the symposium on "The Ecological Aspects of the Emergency Activities of the Government." The second annual conference of investigators engaged in the interpretation of tree rings or in their technology, as developed by Dr. A. E. Douglass and his associates, organized itself on a permanent basis as the Tree Ring Society, with Dr. Douglass as president and H. T. Getty, of the Department of Archeology, University of Arizona, as secretary.

The sixth annual John Wesley Powell lecture was delivered on Monday evening, April 29, at the Museum of New Mexico by Dr. Edgar Lee Hewett, director of the Schools of American Research, on the title: "The Social Sciences in the Program of Education." On May 1 at the Laboratory of Anthropology occurred an important and enthusiastically attended symposium on "Trees: Recorders of History and Climate." The topics and speakers were: I. "Factors Influencing Tree Growth," G. A. Pearson, director of the Southwestern Forest and Range Experiment Station, Tucson. II. "Tree Rings: the Archeologists' Time-Piece," Dr. E. W. Haury, assistant director of Gila Pueblo, Globe, Arizona. III. "Tree Rings: Indicators of Nature's Depression Cycles," Dr. A. E. Douglass, director of the Steward Observatory, University of Arizona, Tucson.

Other general and public lectures were delivered by Dr. W. B. Pietenpol, of the University of Colorado, on "Atomic Nuclei," and by Dr. Walter H. Brown, of Stanford University, on "The Outlook for Public Health Programs in the United States." Under the charge of Colonel C. M. Adams, of the U. S. Public Health Service, there was an exhibit of methods of malaria control in New Mexico, in part illustrated with motion pictures. The annual banquet of the division was held at La Fonda Hotel on Wednesday evening, May 1, following which the retiring president

of the division, Dr. D. S. Robbins, of the New Mexico State College, Las Cruces, made his address on "Science and Religion."

Several brief trips were available to points of interest in and near Santa Fé, and on Thursday, May 2, there was an all-day excursion, of interest especially to archeologists and geologists, to the Bandelier National Monument.

The division as a whole elected officers as follows:

President: Harold S. Colton, director of the Museum of Northern Arizona, Flagstaff.

Vice-president: Jesse L. Nusbaum, Laboratory of Anthropology, Sante Fé, New Mexico.

Secretary-treasurer: Veon C. Kiech, Department of Chemistry, University of New Mexico.

Members of the Executive Committee for 3 years: Stuart A. Northrop, University of New Mexico; E. F. Carpenter, University of Arizona.

Officers of the sections are as follows:

Biological Sciences: Chairman, J. R. Eyer, State College, New Mexico; *Secretary,* R. H. Canfield, Jornade Experimental Range, Alamogordo, New Mexico.

Mathematics: Chairman, F. W. Sparks, Texas Technological College, Lubbock; *Secretary,* W. C. Risselman, State Teachers College, Flagstaff, Arizona.

Physical Sciences: Chairman, S. B. Talmage, New Mexico School of Mines, Socorro, New Mexico; *Secretary,* W. M. Craig, Texas Technological College, Lubbock, Texas.

Social Sciences: Chairman, E. W. Haury, Gila Pueblo, Globe, Arizona; *Secretary,* J. H. Provinse, University of Arizona, Tucson, Arizona.

The sixteenth meeting of the division will be held at Flagstaff and the Grand Canyon, Arizona, from April 27 to 30, 1936, and the seventeenth meeting at Denver, Colorado, jointly with the Pacific Division and the entire association, in June, 1937.

E. F. CARPENTER,
Secretary

STATE ACADEMIES

THE NEW HAMPSHIRE ACADEMY OF SCIENCE

THE seventeenth annual meeting of the New Hampshire Academy of Science was held at McKenzie's Hotel, Franconia, N. H., on Friday and Saturday, May 31 and June 1. The meeting was called to order on Friday at 7:45 P. M. by President Harold A. Iddles. After the presidential address, "The Development of Some Recent Chemical Processes," papers were read by members.

Papers by members were read on Saturday morning, followed by the business meeting. On Saturday afternoon an excursion was made to Wildwood C.C.C. Camp, Lost River, and Franconia Notch. After a banquet on Saturday night, Mr. Richard P. Goldthwait, of the Geology Department of Dartmouth College, gave the invitation lecture, "Living Glaciers in Alaska."

Resolutions were adopted by the academy favoring: (1) A careful and sane revision of the Pure Food and Drug Act; (2) only such advertising as contains statements not misleading; (3) the adoption of legislation adequate to control pollution of public waters, soil erosion and hydraulic development; (4) continued government support of scientific investigation along sane lines; and (5) preventative measures of research and community cooperation in problems of juvenile delinquency.

The following officers were elected for 1935–36: *President,* Albert L. Clough, Manchester Institute of Arts and Sciences; *Vice-president,* Professor George M. Robertson, Dartmouth College; *Secretary-treasurer,* Professor George W. White, University of New Hampshire; *Member of Council,* Professor Harold A. Iddles, University of New Hampshire; *Councillor to American Association for Advancement of Science,* Professor Walter C. O'Kane, University of New Hampshire.

GEORGE W. WHITE,
Secretary-treasurer

SPECIAL ARTICLES

THE LUMBAR LOCALIZATION OF PARALYSIS IN EXPERIMENTAL POLIOMYELITIS AFTER INTRANASAL INOCULATION

IN a recent review of the pathogenesis of poliomyelitis[1] I concluded that the available evidence pointed to a spread of the infection from an entering point in the olfactory mucosa of the nose up to the olfactory bulb and thence downwards through the brain-stem to and through the spinal cord. In the same year (1933), Faber and Gebhardt[2] were able to furnish experimental corroboration of such a direction and pathway of invasion in monkeys, by showing the locations of virus after intranasal instillation on successive days of the incubation period. Since then Schultz and Gebhardt[3] and Brodie and Elvidge[4] have shown that intranasal inoculation (which involves

[1] H. K. Faber, *Medicine,* 12: 83, 1933.

[2] H. K. Faber and L. P. Gebhardt, *Jour. Exp. Med.,* 57: 933, 1933.

[3] E. W. Schultz and L. P. Gebhardt, *Proc. Soc. Exp. Biol. and Med.,* 31: 728, 1934.

[4] M. Brodie and A. R. Elvidge, SCIENCE, 79: 235, 1934.

swallowing by the animal of considerable amounts of virus and hence juxtaposition of virus also with the pharyngeal and gastrointestinal mucosa) is unsuccessful if the connections of the olfactory nerves with the central nervous system are severed, thus completing the demonstration of the olfactory nerves as the essential and probably exclusive pathway of invasion from the body surfaces when such surfaces are not mechanically injured or broken; that is, when conditions of infection are comparable with those occurring in man.

The theory of gastrointestinal invasion has few remaining advocates since the very convincing study of Clark, Roberts and Preston.[5] However, Dr. J. A. Toomey[6] has recently reaffirmed it in somewhat modified form. As an argument against my own views he states: "In the majority of human beings and monkeys, paralysis first develops in the muscles that receive their nerve supply from the lumbar enlargement and only secondarily in those whose nerve supply comes from the cervical area. This fact forms the basis for a fundamental objection to Faber's theory of virus spread."

Through the kindness of Dr. E. W. Schultz and L. P. Gebhardt, of the Department of Bacteriology at Stanford University, I am able to present data on the region of initial paralysis in 57 monkeys, selected at random, all inoculated intranasally by the method they have devised.[7] In these, the infection beyond any reasonable doubt entered through the olfactory nerves and passed through the brain-stem and spinal cord *from above downwards.*

Arms first paralyzed	25, or 43.9	per cent.
Legs first paralyzed	27, or 47.3	per cent.
Arms and legs paralyzed at about the same time	5, or 8.8	per cent.
Total	57	

These experiments in which entrance of infection from the gastrointestinal tract can be ruled out with some certainty and in which, nevertheless, the legs were more often first involved than the arms demonstrate clearly that initial involvement of the lumbar cord can not properly be used as evidence for the theory of the gastrointestinal portal of entry. On the contrary, they prove that the virus in descending through the cord can, and does in more than half the cases, produce its first manifestations in the lower segments. Knowing from previous experiments that the virus is actually present in all levels of the cord,[8] including the cervical, just before as well as when paralysis appears, I see no other possible explanation of the usually earlier and greater lumbar area paralysis than that offered by Fairbrother and Hurst:[9] the anterior horn cells in that area are somewhat more susceptible than others to attack by the virus of poliomyelitis.

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[5] P. F. Clark, D. J. Roberts and W. S. Preston, Jr., *Jour. Prev. Med.*, 6: 47, 1932.
[6] J. A. Toomey, *Ann. Int. Med.*, 8: 854, 1935.
[7] E. W. Schultz and L. P. Gebhardt, *Proc. Soc. Exp. Biol. and Med.*, 30: 1010, 1933.
[8] Faber and Gebhardt, *loc. cit.*

COCCO-BACILLIFORM BODIES ASSOCIATED WITH AN INFECTIOUS FOWL CORYZA

A STUDY of fowl coryza, based on material secured from infected flocks in the vicinity of Princeton, N. J., has shown two distinct clinical types of the disease. The interval elapsing between the injection of exudate in susceptible fowl is short in one case, 1 to 3 days, and prolonged in the other, 1 to 4 weeks. In both types the nasal discharge generally persists for 2 months and often for a longer period.

The fowl coryza bacillus, *Hemophilus gallinarum,* originally described by De Blieck,[1] is constantly associated with the coryza of rapid onset. Intranasal injection of this organism in normal birds is followed by a coryza which, unlike that produced by exudate, is generally of short duration. Moreover, while recovered birds may be resistant to reinfection with the bacillus they are not protected against a subsequent injection of exudate. These two facts have militated against the acceptance of *Hemophilus gallinarum* as the sole cause of the coryza of rapid onset and long duration.

Hemophilus gallinarum is not associated with the coryza of slow onset; attempts to isolate it from the nasal passages of infected birds have repeatedly failed. Generally the exudate does contain other bacteria, most of which grow freely in cultures. It can be said with certainty that all these bacteria are secondary invaders and of no direct etiological significance. It can also be stated that the responsible infective agent is unable to pass through Berkefeld V candles of average permeability.

It was found, however, that sterile filtrates from a V candle of abnormal permeability contained the infective agent and produced a coryza of slow onset in normal fowl. Bacteria free exudate, which is sometimes present in the orbital sinuses of infected birds, also proved to be infective.

Exudate from two birds originally infected with filtrate has been carried on in series by passage from infected to susceptible birds. Films made directly from this exudate, which regularly contains few bac-

[9] R. W. Fairbrother and E. W. Hurst, *Jour. Path. and Bact.*, 33: 17, 1930.
[1] L. De Blieck, *Vet. Jour.*, 88: 9, 1932.

teria, have constantly shown minute Gram negative cocco-bacilliform bodies. They are commonly extracellular; occurring singly, in pairs, or in loosely formed aggregates, but may also be found intracellularly within both phagocytic and epithelial cells. They vary somewhat in size, with an estimated range of 0.1 to 0.5 μ, many of them approaching the limit of visibility with the ordinary microscope. Early in the disease the bodies are generally numerous, but in some cases their detection requires a prolonged search. The same bodies are also present in films made from the nasal passages of birds injected with unfiltered exudate. Their detection is often more difficult in this case, due to the presence of numerous bacteria.

All attempts to cultivate these bodies, either aerobically or anaerobically, in artificial media have met with failure. In several instances, however, there has been isolated a minute Gram-bacillus which tends to form compact clumps in fluid cultures. This organism, which is not pathogenic, bears a superficial morphological resemblance to the cocco-bacilliform bodies, and like them is capable of passing through certain Berkefeld V candles. Whether or not it is in any way related to these bodies can not be stated at present.

The injection of exudate from birds infected with the coryza of rapid onset into birds which have recovered from the coryza produced by injection of *Hemophilus gallinarum* is often followed by a coryza of slow onset which may be reproduced in series. *Hemophilus gallinarum* is not present in the exudate in these cases. Stained films, however, show cocco-bacilliform bodies indistinguishable from those which characterize the more naturally produced disease. These findings suggest that the coryza of rapid onset and long duration is in reality a mixed infection in which both *Hemophilus gallinarum* and the present virus, of undetermined nature, are operating. Such a relationship would offer an adequate explanation for the previously noted discrepancies in the coryzas produced by exudate and culture, respectively.

Gibbs[2] has recently stated that the causative agent of a fowl coryza with which *Hemophilus gallinarum* was not associated was capable of passing through certain celloidin membranes and estimated that the diameter of the agent was between 80–120 mμ. Filterability is not, however, a trustworthy characteristic for the classification of an infective agent. The present bodies may also be considered as filterable. The smaller forms certainly do not exceed 100 mμ in diameter. They are morphologically similar to the bodies which characterize fowl pox, vaccinia and psittacosis, but also resemble the Rickettsiae of typhus and allied diseases. The present knowledge of the coryza bodies is, however, too meager to warrant a statement as to their nature. It is realized that the implied relationship of them to the etiology of coryza rests on purely circumstantial evidence and that a final appraisal must await their recovery or cultivation in a pure state.

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THE ROLE OF LIPOIDS IN THE X-RAY DIFFRACTION PATTERNS OF NERVE

IN order to obtain greater detail with respect to the 40–45 Å equatorial spacings previously reported for medullated nerve,[1] photographs were made with very small pinholes (0.2 mm), with well-centered small beads and with distances of 10–20 cm from specimen to plate (copper $K\alpha$ radiation). These photographs revealed large well-oriented spacings previously unsuspected for animal tissues. Because of the light which this work throws on the interpretation of nerve diffraction patterns and because of the biological significance of the lipoids, to which these large spacings apparently are due, we wish to describe briefly these results.

The rôles of the myelin and the axis cylinder in the diffraction patterns of nerve were investigated by studying photographs obtained from the lipoid and protein constituents of nerve separately. When rubbed up with water the solids obtained by evaporation of a benzene-alcohol extract of dried cow spinal cord gave patterns similar to those of fresh medullated nerve as exemplified by corpus callosum or motor roots. The dried lipoid patterns are similar to those of dried medullated nerve, with the exception of the equatorial points at 11.5 Å observed in the latter. This spacing was duplicated by fibers spun from nucleoprotein extracts of cow spinal cord and lobster claw nerves and presumably corresponds to the side-chain distance of these protein macromolecules.[2]

The lipoid constituents of the myelin sheath of fresh medullated nerve appear to be organized in a manner such as to form a single type of fluid crystal which gives a spacing in its long direction of approximately 171 Å. This is strongly indicated by the fact that the spacings observed are 85.5, 56.8, 42.7 and 34.2 Å with the even orders strongest and the odd orders weakest; each of the rings has strong equatorial accentuation. Upon drying nerve yields principally

[1] F. O. Schmitt, G. L. Clark and J. N. Mrgudich, SCIENCE, 80: 567, 1934.

[2] The protein extraction and fiber spinning was performed as described by F. O. Schmitt and R. S. Bear, *Proc. Soc. Exper. Biol. and Med.*, 32: 943, 1935.

[2] C. S. Gibbs, SCIENCE, 81: 345, 1935.

a strong equatorial point at 71 Å and a ring with equatorial accentuation at 43 Å; a faint equatorial point occurs also at approximately 140 Å. Apparently drying causes a separation of lipoid components, one remaining oriented while another becomes somewhat disoriented. Another indication of the tendency of drying to separate the lipoid components of the myelin sheath is observed in the meridianally sickled 4.7 Å ring of medullated nerve. Upon drying the nerve this ring becomes resolved into a number of rings, of which the most prominent are those at 4.2, 4.7, 5.2 and 5.9 Å. These spacings are found also in dried lipoids extracted from cow spinal cord. The 4.2 and 4.7 Å rings are typical of dried lecithin, those at 5.2 and 5.9 Å of cholesterol. Moreover, such a separation of mixed lipoid crystals upon drying has been shown to occur in artificial mixtures of lipoids. The patterns obtained from such mixtures show considerable variability, depending upon the degree of hydration and the relative proportions of the individual constituents.

Although it was previously demonstrated[3] that the 15.5 Å equatorial sickles of fresh nerve are not due to connective tissue, as claimed by Boehm,[4] the present work shows that this spacing can be duplicated by wet nerve lipoids and is, therefore, interpreted best as a higher order reflection from the extremely well-oriented lipoids in the myelin sheath. This interpretation is strengthened by the fact that with drying this spacing fades out both in medullated nerve and in nerve lipoids.

The well-known tendency of lipoids to combine tenaciously with proteins,[5] their frequent association in living cells, and the wealth of diffraction spacings given by lipoids, as illustrated above, all indicate the necessity of distinguishing carefully between the lipoids and proteins in diffraction pictures of biological materials.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

METHOD FOR STUDY OF CRYSTALS FOUND IN AMOEBA BY MEANS OF X-RAYS

THE following method seems to present a very interesting way for finding out the nature of the crystals which are present in some of the vacuoles in Amoeba.

The crystals were prepared for the x-ray picture by putting a few Amoebae which had been carefully washed in several changes of redistilled water on a thin collodion membrane which was stretched over a small round hole which had been drilled in one end of an ordinary glass slide. After the amoeba had settled to the bottom, the excess water was drained off with filter paper, and the amoebae fixed with absolute alcohol. Another thin layer of collodion was added to cover these.

The x-rays were directed on one of these amoebae and then enlarged by means of a pinhole camera. The important features of the photograph obtained are presented in the diagram. On the photograph three or four faint Laue spots are present and the three most distinct ones are represented in the diagram by the spots A, B and C. These seem to indicate that there are one or more definite crystals present which can be investigated further by this method, but are insufficient for identification purposes. The faint outer circle surrounding the central part is probably due to the presence of the collodion membranes used to support the crystals. These investigations are now being continued and preparations of millions of crystals used instead of a few crystals. In this way it is hoped that we will get a series of diffraction spots and thus enable us to identify the crystals if they are like any that are already known.

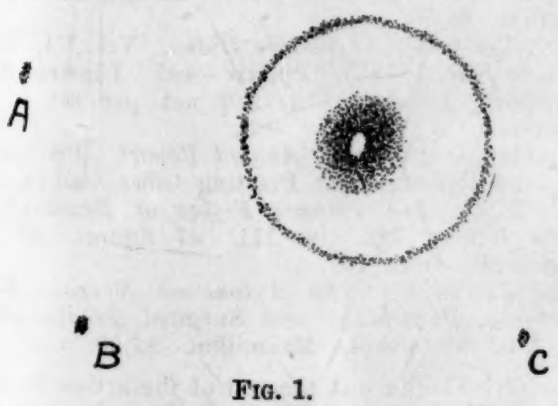

FIG. 1.

The author is greatly indebted to Dr. Maurice Huggins for supervising the taking of the x-ray pictures and explaining the results obtained.

COLEEN FOWLER

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VARIABLE TENSION CLAMPS FOR PHYSIOLOGY EXPERIMENTS

THREE marking pens record nicely on the smoked paper, but the fourth drags. The fourth is fixed and

[3] SCIENCE, 80: 567, 1934.

[4] G. Boehm, *Koll. Zeitschr.*, 62: 22, 1933.

[5] See, for example, S. P. L. Sørensen, *Koll. Zeitschr.*, 53: 102, 170, 360, 1930.

the drum started when it is discovered the other points need adjustment. A scientific paper is no place to record the observations of physiologists under such conditions—even though they be accurate!

To meet the need for a low-priced variable tension clamp for the physiology laboratory two clamps of slightly different construction have been designed. The main differences in numbers 1 and 2, in the accompanying figure, are the springs and the construction of the joint between the two halves. In clamp 1 there is a helical spring (c) and the male piece A is held accurately in place by the u-shaped female piece B. Clamp 2 has a flat v spring held in place by notches in both A and B.

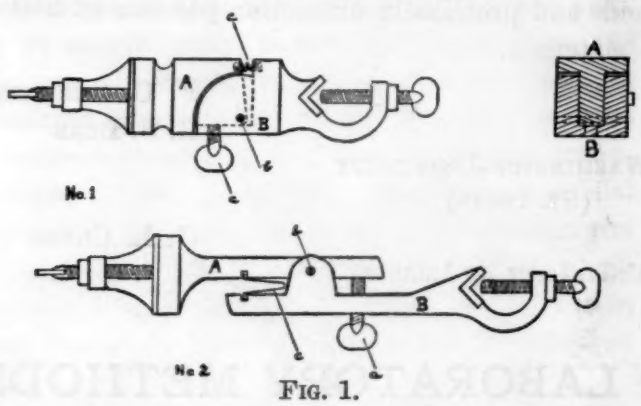

FIG. 1.

Part A of both clamps holds recording devices, while the other half goes on the support. The friction of the writing points against the smoked paper is easily changed by regulating the screw (a) which pushes against the flat surface of part A. The pin (b) holds the two halves of the clamp in place.

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A DEVICE FOR PERMANENTLY MARKING LABORATORY ANIMALS

TATTOOING is probably the best of the methods for marking laboratory animals such as rabbits and monkeys, but is seldom used because of the cost of commercial electrical tattooing machines and because of the undue labor necessary to properly tattoo by hand. Below is described a simple and inexpensive machine.

The apparatus is made from a commercial type of electric razor[1] which can be purchased for about one dollar. The guard and a portion of the removable head are cut off and a special head, constructed as shown in Fig. 1, is soldered or brazed into position. The adjustable housing for the needle, which serves both as a guide for the tattooing needle and as a reservoir for the ink supply, is made from a hypodermic needle of the proper gauge to permit free motion of the needle within it. The tattooing needle is made from a sewing needle, one end of which is softened in a flame and shaped to fit without binding over the vibrating member of the head. The needle must be retempered before use by plunging it, after heating to a red heat, into an oil bath. The housing should be adjusted so that the needle extends about 0.5 mm beyond the tip when at its maximum point of oscillation. To facilitate marking, the apparatus should be connected in series with a foot switch[2] to the 110 volt alternating current supply.

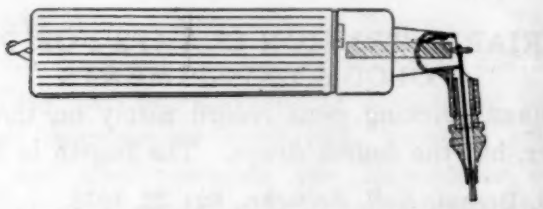

FIG. 1. A device for permanently marking laboratory animals.

The ear of the animal to be tattooed is cleaned with acetone or ether, then the tip of the apparatus, previously filled with India ink, is pressed firmly against the ear and the current turned on. Marking is done at the rate of 2–3 mm per second. Excess ink should be removed with acetone.

Incidentally, this apparatus can be used to excellent advantage in preparing fine designs on mimeograph stencils. For this purpose a sheet of paper on which the desired design has been traced should be placed over the stencil.

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[1] Tark razor.
[2] Floorboard switch for double beam headlights, as used on General Motors cars.

BOOKS RECEIVED

Le Travail Par Équipes A L'École. Pp. 230. Bureau of International Education, Geneva. Fr. suisses 4.–

LUCK, J. MURRAY, Editor. *Annual Review of Biochemistry.* Pp. vii + 639. Volume IV. Stanford University Press. $5.00.

MCCRAE, THOMAS, Editor. *The Principles and Practice of Medicine* by the late Sir William Osler. 12th edition, revised. Pp. xxvii + 1196. 22 figures. Appleton-Century. $8.50.

MARTIN, THOMAS. *Faraday's Diary.* Vol. VI, Nov. 11, 1851, to Nov. 5, 1855. Pp. xiv + 495. Illustrated. Bell and Sons, London. 12/12/0 net per set of seven volumes.

Smithsonian Institution. *Annual Report.* Pp. xiv + 476. 59 plates. Government Printing Office. $0.70.

WADE, R. T. *The Triassic Fishes of Brookvale, New South Wales.* Pp. xiv + 111. 47 figures. 10 plates. British Museum. 10/.

WHITE, JAMES C. *The Autonomic Nervous System: Anatomy, Physiology and Surgical Treatment.* Pp. xv + 386. 96 figures. Macmillan. $7.00.

Erratum: The date at the end of the article by Professor M. S. Kharasch and Dr. R. R. Legault, page 615 in the issue of SCIENCE for June 21, should be 1933 instead of 1923.